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MINNESOTA'S FOREST RESOURCES

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Forest Service
United States Department of Agriculture
Forest Resource Report No. 13

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FOREST RESOURCE REPORT NO. 13 OCTOBER 1958

Minnesota's Forest Resources

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LAKE STATES FOREST EXPERIMENT STATION

(Maintained by the Forest Service, U. S. Department of Agriculture, at St. Paul 1, Minn., in cooperation with the University of Minnesota)

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Preface

THE McSWEENEY-McNARY Forest Research Act of May 22, 1928, authorized the Secretary of Agriculture to make and keep current a survey of the Nation's forest resources. In 1933 the Lake States Forest Experiment Station of the Forest Service, U. S. Department of Agriculture, initiated the first complete field inventory of the forest resources of Minnesota as part of the nationwide forest survey. The Minnesota survey was completed in 1936 and, for the first time, provided reasonably accurate data showing the area, volume, growth, and drain of forest resources. (Reported in *The Forests of Minnesota*, by R. N. Cunningham and H. C. Moser, U. S. Forest Service Lake States Forest Experiment Station, 1938.)

By 1946 the earlier data needed bringing up to date and a cooperative survey was planned. The Lake States Forest Experiment Station took responsibility for planning and coordinating various segments of the job and contributed to field and office work. The National Forest organizations, the Bureau of Indian Affairs, and the Minnesota Department of Conservation assumed responsibility for surveying public lands under their jurisdiction. The Iron Range Resources and Rehabilitation Commission assumed responsibility for covering lands outside public forests. As the work progressed, individual counties and several private industries participated. The entire job was completed in 1953. The Iron Range Resources and Rehabilitation Commission has published detailed reports covering the entire State, either by individual counties or groups of counties.

This report is a résumé of forest statistics for the State as a whole. It incorporates data collected by all cooperating agencies. Analysis of the statistics, comparison with previous surveys, and any conclusions drawn are the responsibility of the authors. The opinions expressed may or may not be shared by the other agencies.

In any comprehensive planning program dealing with the forest resource, other integrated uses and values besides wood production must be given careful consideration. These include water resource management, fish and wildlife, and recreational uses and other sociological needs. Although the scope and intent of this publication do not permit their inclusion, the authors are nonetheless aware of their vital importance.

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A Midcentury Checkup

VERY STRIKING CHANGES have occurred in the forest situation in Minnesota during the past 50 years.

Originally, Minnesota is supposed to have had about 31.5 million acres of forest out of a total land area of 51.2 million acres. At the beginning of the 20th century, large areas in the North were still occupied by virgin forest. Dozens of large sawmills were operating around Duluth and along the Mississippi and St. Croix Rivers. Lumber and logs were being exported to nearby States. Total cut in 1899 was reported to be 2.3 billion board-feet.

By 1926 the accessible virgin timber had been largely harvested. Forest fires, especially in 1908, 1910, and 1918, had left serious scars. Lumber production had dropped to around 0.5 billion feet per year. Today only a few scattered remnants of the virgin forest remain (fig. 1).

Significant restoration activities started during the 1930's, but effects were not yet in evidence when the first forest survey was completed in 1936. At that time the forest area had shrunk to 19.6 million acres, of which part was unavailable for timber production.

Between 1936 and 1953 substantial progress was made in reducing losses from forest fires. Large areas of cutover land were incorporated in public forests, and many denuded areas were planted. Some industrial forests were started, and public programs were initiated to stimulate improved management of farm woodlands and other privately owned tracts. The current forest survey, finished in 1953, gives a complete picture of present forest conditions and, by comparison with the previous one of 1936, gives a basis for observing trends. The following are some of the notable features.

Forest-type areas:	*Original (million acres)*	*1936 survey (million acres)*	*1953 survey (million acres)*
Pine	5.8	1.6	1.3
Spruce-fir	6.3	1.1	1.2
Conifer swamp	6.1	2.5	2.0
Upland hardwood	8.4	1.9	2.0
Lowland hardwood	2.0	.6	1.1
Aspen-grass-brush	...	10.4	10.5
Nonproductive and other [1]	2.9	1.5	1.2
Total	31.5	19.6	19.3

Growing stock area:	*1936 Thousand acres*	*1953 Thousand acres*
Sawtimber stands:		
Softwood types	644	548
Hardwood types	876	1,469
Poletimber stands:		
Softwood types	2,077	1,855
Hardwood types	2,340	3,426
Total	5,937	7,298
Density of young stands:		
Medium- and well-stocked seedlings and saplings	4,106	4,646
Poorly stocked seedlings and saplings	4,289	1,671
Total	8,395	6,317
Area of nonstocked commercial forest land:		
Upland	1,887	1,748
Swamp	1,881	2,735
Total	3,768	4,483

Timber volume:	*Original [2] (billion bd.-ft.)*	*1936 survey (billion bd.-ft.)*	*1953 survey (billion bd.-ft.)*
Total sawtimber	126.0	11.3	12.5
Softwood	90.0	6.3	5.0
Hardwood	36.0	5.0	7.5
	Billion cu. ft.	*Billion cu. ft.*	*Billion cu. ft.*
Total timber	41.5	6.4	7.2
Softwood	29.0	3.0	2.8
Aspen	.....	1.5	1.8
Other hardwood	12.5	1.9	2.6

Growth-cut (drain)—allowable cut: [3]	*Million cu. ft.*	*Million cu. ft.*
All softwood:		
Annual growth	99	118
Annual cut (drain)	60	78
Allowable annual cut	49	96
All hardwood:		
Annual growth	179	267
Annual cut (drain)	50	76
Allowable annual cut	108	151

[1] In 1936 and 1953, this includes approximately 0.4 million acres of land reserved from timber production, some of which is productive timberland.

[2] Conservatively estimated at 5 M board-feet (or 20 cords) per acre for softwood types and 3.5 M board-feet (or 15 cords) per acre for hardwood types.

[3] This and other Forest Survey terms are defined in the appendix.

FIGURE 1.—*Grove of red pine sawtimber. Timber of this quality now occurs only in small scattered patches or on lands reserved from cutting. (Photo courtesy of Minnesota & Ontario Paper Co.)*

The overall situation described by these statistics has both favorable and unfavorable aspects. Unquestionably, the State's forest lands at midcentury are far below desirable forestry standards in such matters as volume of growing stock, distribution of age classes, species composition, and quality of timber. There is evidence that the softwoods have been losing ground, not only early in the century but to some extent since 1936. For these reasons the current yields (both actual cut and allowable cut) are far below the capacity of the land to produce timber.

On the other hand, reforestation programs, improved protection, and improved management on parts of the area since 1936 have reduced the area of poorly stocked seedlings and saplings and increased pole and sawtimber stands (primarily hardwood). The same factors have stimulated annual growth and, together with improved roads and logging equipment, have added substantially to the allowable annual cut.

The picture is encouraging since it suggests that Minnesota forests have touched bottom and are now on the upgrade. It shows that they respond rather promptly to improved treatment. It suggests that even now there are opportunities for expansion of industries using selected materials and that these opportunities seem likely to grow.

The picture is less encouraging with respect to the species, size, and quality of timber becoming available on lands not yet under management; it suggests that much more forestry work remains to be done.

Undoubtedly the second half of the century will see changes fully as large and important as those of the first half. Because of rapidly changing conditions in the forest and uncertainties as to the intensity of forest management and utilization in the years ahead, only crude forecasts of future yields can be offered at this time. To chart the course of actual forest development in the State is the job for future surveys.

The Forest Resource

Forest Lands

OF MINNESOTA'S 51,206,000 acres of land, 19,344,000 are forest land (fig. 2). Of this total, 818,000 acres are unproductive for timber, and 428,000 acres are reserved from cutting by legislation, leaving 18,098,000 acres or 35 percent of the land area as commercial forest available for raising timber crops (table 1). Eighty percent of the commercial forest land is concentrated in the northeastern division of the State (see cover), 12 percent in the southeastern division, and only 8 percent in the western division.

TABLE 1.—*Land areas, by major classes of land and geographic division, Minnesota, 1953*

Class of land	Total	Division		
		North-eastern	South-eastern	Western
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*
Forest:				
Commercial	18,098	14,426	2,166	1,506
Noncommercial:				
Reserved [1]	428	424	2	2
Unproductive [2]	818	768	24	26
Total	19,344	15,618	2,192	1,534
Nonforest: [3]				
Farm	25,078	1,996	6,819	16,263
Other	6,784	1,822	2,049	2,913
Total	31,862	3,818	8,868	19,176
All land	51,206	19,436	11,060	20,710

[1] Land in State parks, and Federal and State recreational reserves where cutting of timber is prohibited by law or regulations.

[2] Poor swamp and other more or less wooded land judged incapable of producing merchantable pulpwood or sawtimber within 100 years. It includes 7,000 acres withdrawn for special uses.

[3] Includes 556,200 acres of water, according to Survey standards of area classification but defined by the Bureau of Census as land.

Main Commercial Forests in the North

The northeastern division, consisting of 16 counties extending westward from Lake Superior to the edge of the prairie country and south from the Canadian border to Mille Lacs Lake, is the most heavily forested part of the State (fig. 3). Originally it supported as almost pure coniferous forest of white pine, red pine, jack pine, black spruce, white spruce, balsam fir, tamarack, and white cedar. Even now, 80 percent of the land is forested; only 10 percent is nontimbered farmland (fig. 4). Logging and fires, however, have drastically altered the composition of the forest and the size of the timber.

Southern and Western Forests Mostly Farm Woods

The southeastern division, with 27 counties, extends diagonally from Otter Tail County in the northwest to Houston County in the southeastern part of the State. Originally it was forested, but today it is primarily a farming country with but 20 percent of the land in woods (fig. 5). Conifers cover only a negligible part of the forested land.

The western division, consisting of 44 counties, has only 7 percent of its land area in commercial forest. With few exceptions, the "forest" consists of planted shelterbelts adjacent to farm homes or scattered natural tracts along stream bottoms. A few types characteristic of the northeastern forest extend into the Red River Valley. Otherwise, the natural stands are hardwood. Trees generally are short and timber quality is poor.

Few Sawtimber Stands Remain

Sawtimber stands now cover only a small part of the commercial forest area of the entire State. Second-growth forests ranging from seedlings to pole size cover nearly two-thirds of the land, while one-fourth is presently deforested (table 2).

In the northeastern division, partly because of species characteristics and partly because of cutting and fires, sawtimber stands cover only 7 percent of the commercial forest area. In the southeastern division, sawtimber occupies 34 percent, while in the western division it accounts for 18 percent of the commercial forest area. In each division, poorly stocked and deforested lands make up a large segment of the total (fig. 6).

FIGURE 2.—*Forests add much to the beauty of Minnesota's 10,000 lakes. More than 400,000 acres in parks and lakeside strips have been reserved from cutting.* (*Photo courtesy Minnesota Conservation Department.*)

FIGURE 3.—*The northeastern division, once heavily timbered with white pine, red pine, spruce, and fir, now supports extensive stands of aspen with intermingled softwoods. Lands are mostly level or gently rolling with numerous lakes and swamps in depressions.* (*Photo courtesy of Minnesota Conservation Department.*)

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TABLE 2.—*Stand-size class and stocking density on commercial forest land, by geographic division, Minnesota, 1953*

Stand-size class	Total		Division		
			North-eastern	South-eastern	Western
	Thousand acres	*Percent*	*Thousand acres*	*Thousand acres*	*Thousand acres*
Sawtimber stands	2,017	11	1,008	732	277
Poletimber stands	5,281	29	4,327	580	374
Seedling and sapling stands:					
Medium to well-stocked	4,646	35	4,005	333	308
Poorly stocked	1,671		1,405	107	159
Nonstocked [1]	4,483	25	3,681	414	388
All stands	18,098	100	14,426	2,166	1,506

[1] Includes 2,735,000 acres of deforested swamp.

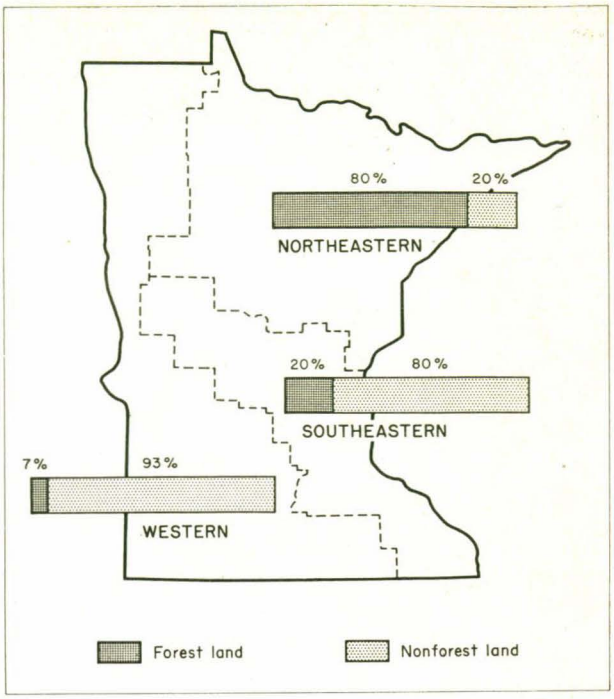

FIGURE 4.—*Proportion of forest and nonforest lands for the major forest divisions of the State.*

Original Softwood Forests Now Partly Displaced by Aspen and Brush

Only one-fourth of the commercial forest acreage is now occupied by softwood timber types—pine, spruce, spruce-fir, tamarack, and cedar—whereas, more than one-half of the original forest was softwood. Of the rest, one-fourth is nonstocked and one-half is hard-

FIGURE 5.—*The southeastern division is primarily a farming country but has 20 percent of the land wooded. Ash, elm, and cottonwood follow the streambanks. Maple, oak, and basswood groves occupy untilled upland parts of the farms. A few tamarack swamps and occasional windbreak plantings of spruce or pine make up virtually the only softwood forests in the division. (Photo courtesy Mark Hurd Aerial Surveys.)*

FIGURE 6.—*A large share of the Minnesota forest land consists of deforested and partially restocked areas. Pine sawtimber on such lands exists mainly as scattered clumps or isolated trees. (Photo courtesy Minnesota Conservation Department.)*

wood types (table 3). Of the hardwood area, aspen claims almost 65.4 percent, making it the dominant individual type in the State (fig. 7).

TABLE 3.—*Commercial forest area, by forest type and geographic division, Minnesota, 1953*

Forest type	Total	Division		
		North-eastern	South-eastern	Western
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*
Softwood:				
White pine	125	121	4	----------
Red pine	166	163	3	----------
Jack pine	986	932	17	37
Spruce-fir	1,233	1,226	2	5
Black spruce	1,169	1,143	1	25
Tamarack	482	433	28	21
Cedar	284	283	----------	1
Total	4,445	4,301	55	89
Hardwood:				
Oak-hickory	1,182	186	844	152
Elm-ash-cottonwood	1,145	596	244	305
Maple-birch	846	520	235	91
Aspen-birch	5,997	5,142	374	481
Total	9,170	6,444	1,697	1,029
Nonstocked	4,483	3,681	414	388
All types	18,098	14,426	2,166	1,506

Softwood types are important chiefly in the northeastern division where they account for 30 percent of the forest area (fig. 8). Largest individual type is the spruce-fir, which is a mixture of balsam fir, white spruce, aspen, paper birch, and a wide variety of other softwoods and hardwoods able to grow on cool, moist sites. Another large type is the black spruce, which occupies more than 1 million acres of swampland (fig. 9). White pine and red pine types have been reduced to a rather small acreage, but jack pine covers nearly 1 million acres in the northeastern division. Tamarack and cedar also grow in the northern swamps.

Hardwood types extend throughout the State. Aspen has come in following logging, burning, and land clearing in the northeastern division. Oak is the principal type in the southeastern division. The elm-ash-cottonwood type occupies stream bottoms and river terraces throughout the State. Species composition, of course, varies for the several divisions. The maple-beech-birch type (which in Minnesota lacks beech entirely and has much more basswood than yellow birch) is at the western extremity of its range but occupies significant acreage.

Of the nonstocked land, which makes up about one-fourth of the total forest area, 2,735,000 acres are classified as lowland brush, which means that they are of

FIGURE 7.—*Aspen is now the dominant individual type in the State, having replaced much of the white pine, spruce, and fir in the north and some of the northern hardwoods and oak elsewhere. (Photo courtesy Minnesota Conservation Department.)*

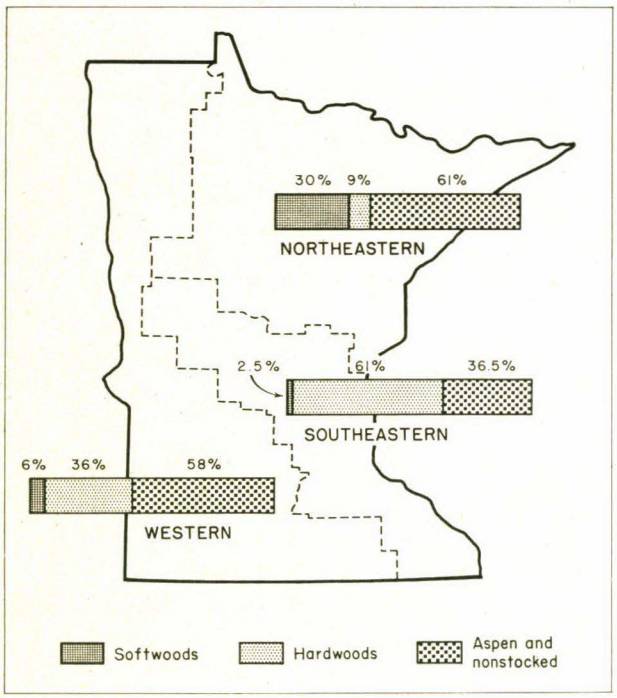

FIGURE 8.—*Proportions of forest types in Minnesota, by geographic division.*

swampy character and present very difficult problems in reforestation. A large share of the 1,748,000 acres classified as upland grass or upland brush are plantable (fig. 10). Some of this land was cutover during the recent war and has not yet restocked, while other land has too dense a cover of grass or brush to permit restocking.

Federal, State, and County Ownership Large

Although public agencies control only 27 percent of the total land area in Minnesota, they control 56 percent of the forest area. Farmers own 64 percent of all land but only 27 percent of the forest area (table 4).

Publicly owned forest lands are of greatest significance in the northeastern division where they make up 66 percent of the total (table 5). They include two national forests, several Indian forests, and a large number of State, county, and municipal forests. In the southern and western divisions, publicly managed forest lands consist mainly of scattered tracts managed only incidentally for timber production.

FIGURE 9.—*Poletimber stand of black spruce being cut for pulpwood. Black spruce is one of the most valuable types remaining in the State. (Photo courtesy Minnesota & Ontario Paper Company.)*

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FIGURE 10.—*A tract converted from poletimber to upland grass and brush by clear cutting during World War II. This area probably will require planting to reestablish a good forest cover.*

TABLE 4.—*Commercial forest land, by ownership and stand-size class, Minnesota, 1953*

Ownership class	All land	Commercial forest land				
		Total	Sawtimber stands	Poletimber stands	Seedling and sapling stands	Nonstocked and other areas[1]
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*
Federally owned or managed:						
National forest	2,652	2,195	314	865	785	231
Indian	866	717	60	255	190	212
Bureau of Land Management	93	49	2	13	15	19
Other	201	94	13	29	28	24
Total	3,812	3,055	389	1,162	1,018	486
State	5,028	3,484	202	967	1,178	1,137
County and municipal	4,799	3,619	146	985	1,585	903
Private:						
Farm	32,883	4,881	983	1,268	1,379	1,251
Industrial and other	4,684	3,059	297	899	1,157	706
Total	37,567	7,940	1,280	2,167	2,536	1,957
All ownerships	51,206	18,098	2,017	5,281	6,317	4,483

[1] Includes areas not classified elsewhere.

TABLE 5.—*Commercial forest land by ownership and geographic division, Minnesota, 1953*

Ownership class	Total	Division		
		Northeastern	Southeastern	Western
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*
Federally owned or managed:				
National forest	2,195	2,195		
Indian	717	673	1	43
Bureau of Land Management	49	46		3
Other	94	44	39	11
Total	3,055	2,958	40	57
State	3,484	3,251	48	185
County and municipal	3,619	3,293	244	82
Private:				
Farm	4,881	2,123	1,676	1,082
Industrial and other	3,059	2,801	158	100
Total	7,940	4,924	1,834	1,182
All ownerships	18,098	14,426	2,166	1,506

Privately owned forests, other than farm woodlots, total 3,059,000 acres. Only about one-sixth of this total is owned by forest industries, but this portion includes some of the better stands of original and second-growth timber as well as promising young growth (fig. 11).

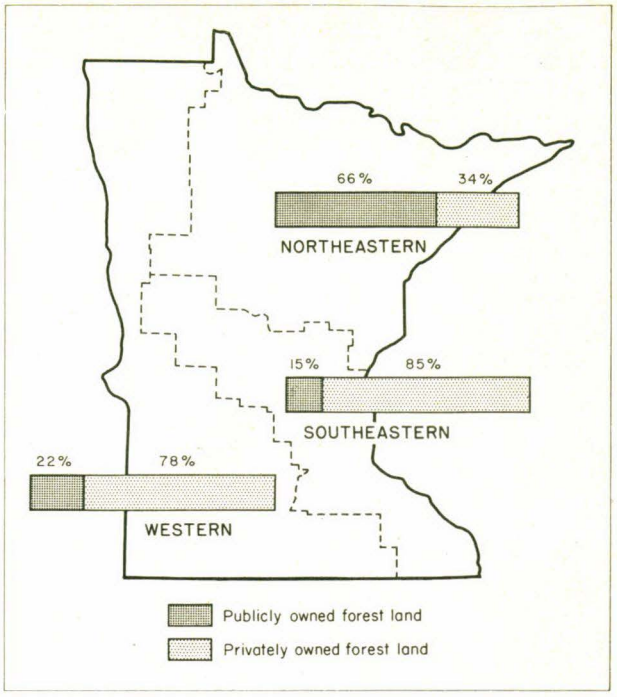

FIGURE 11.—*Forest land ownership in Minnesota, by geographic division.*

Forests Now in Transition

Although the survey completed in 1936 was based on slightly different standards of merchantability and used a different method of forest sampling than the current survey, the overall pattern of changes in the forests is discernible. In some aspects the forests have changed for the better, while in others they have retrogressed.

Estimates of total commercial forest area when adjusted to a common basis show little change between surveys (table 6). Some clearing of forest land for agriculture and other uses has been balanced by reversion of submarginal farms to forest.

Softwood Area Still Shrinking

Although total forest area has not changed much since 1936, its composition has been altered (fig. 12). Softwood types declined from approximately 5,171,000 acres in 1936 to 4,445,000 acres in 1953. This decline was caused primarily by cutting during World War II when demand was extremely strong for the valuable pines and long-fibered pulp species. A small part of the decline may be the result of changes in type definitions wherein some swamplands previously classified as spruce or tamarack were given a nonforest status because of poor stocking and inherent

TABLE 6.—*Comparison of 1936 and 1953 commercial forest areas in Minnesota, by forest type and stand-size class*

Forest type	Total		Sawtimber		Poletimber		Restocking	
	1936	1953	1936	1953	1936	1953	1936	1953
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*
Softwoods:								
White pine	224	125	114	92	88	23	22	10
Red pine	167	166	60	102	77	37	30	27
Jack pine	1,219	986	269	199	505	447	445	340
Spruce-fir	1,053	1,233	153	109	479	528	421	596
Black spruce	1,475	1,169	19	8	598	468	858	693
Tamarack	655	482	9	9	145	215	501	258
Cedar	378	284	20	29	185	137	173	118
Total	5,171	4,445	644	548	2,077	1,855	2,450	2,042
Hardwoods:								
Oak-hickory	988	1,182	111	493	547	420	330	269
Elm-ash-cottonwood	607	1,145	106	411	199	480	302	254
Maple-birch	886	846	281	296	248	293	357	257
Aspen-birch	6,680	5,997	378	269	1,346	2,233	4,956	3,495
Total	9,161	9,170	876	1,469	2,340	3,426	5,945	4,275
Nonstocked	3,768	4,483	------	------	------	------	------	------
All types	18,100	18,098	1,520	2,017	4,417	5,281	8,395	6,317

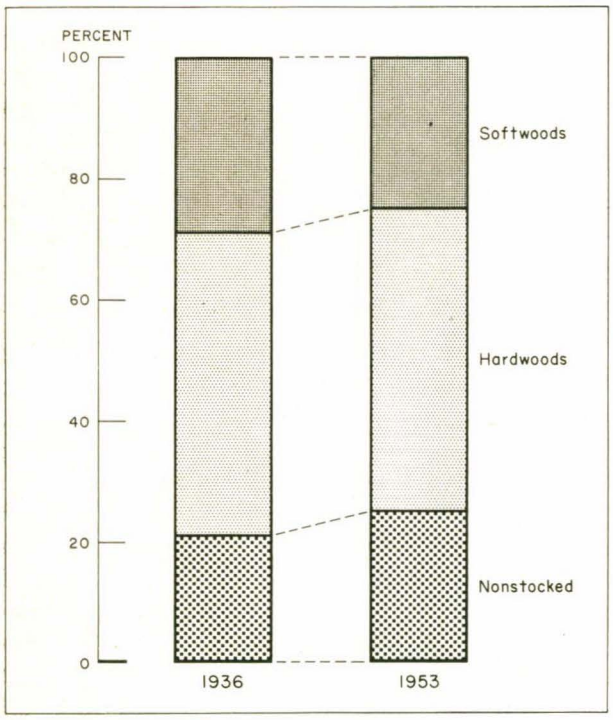

FIGURE 12.—*Comparison of commercial forest areas by major forest type groups, 1936 and 1953.*

low productivity. Changes in type classification are possible also in marginal conditions where forests are made up of mixed hardwoods and softwoods. Overall, however, indications are that softwood types have been losing ground gradually during the 17-year period between surveys.

The proportion of area in the several stand sizes has changed very little for the softwood type group as a whole. Sawtimber area declined from 644,000 acres in 1936 to 548,000 acres in 1953 but still made up a little more than 12 percent of the total.

Sapling Stands "Thickening Up"

Although the acreage of seedlings and saplings in softwood types declined from 2,450,000 acres in 1936 to 2,042,000 acres in 1953, the stands at the latter date were much better stocked. Whereas about 45 percent of the young stands was reported poorly stocked in 1936, only 30 percent was so classified in 1953. Improved fire protection is believed to be the chief factor in the change.

Many of the medium-to-well-stocked sapling stands should be large enough to support thinning operations within the next 10 to 20 years (fig. 13).

New Hardwood Combinations Evolving

A number of significant changes occurred in the hardwood types between 1936 and 1953. The elm-ash-cottonwood type gained substantially over the 1936 estimate (fig. 14). The maple-birch type declined by 9 percent, while the aspen-birch acreage went down by 10 percent. Much of the big increase in elm-ash-cottonwood area probably was made at the expense of spruce-fir and white pine types. Some jack pine has changed to oak. Upon being "high graded" for softwood products, these types commonly revert to the hardwood types. The maple-birch type probably has lost some area through clearing for pasture or crops. Some aspen has been converted to spruce-fir and other hardwoods through natural succession. Also, more aspen restocking stands may have been classified as "off site" (i. e., nonproductive) in 1953 than in 1936, thus reducing the area of commercial aspen type. The hardwood types, in addition to enlarging their area, have advanced in average size and density since 1936.

FIGURE 13.—*Young pine stand that will be ready to be thinned for pulpwood within the next decade. Large acreages of potential pine land occupied now by scrubby aspen, grass, and brush could be restored by planting. (Photo courtesy Minnesota Conservation Department.)*

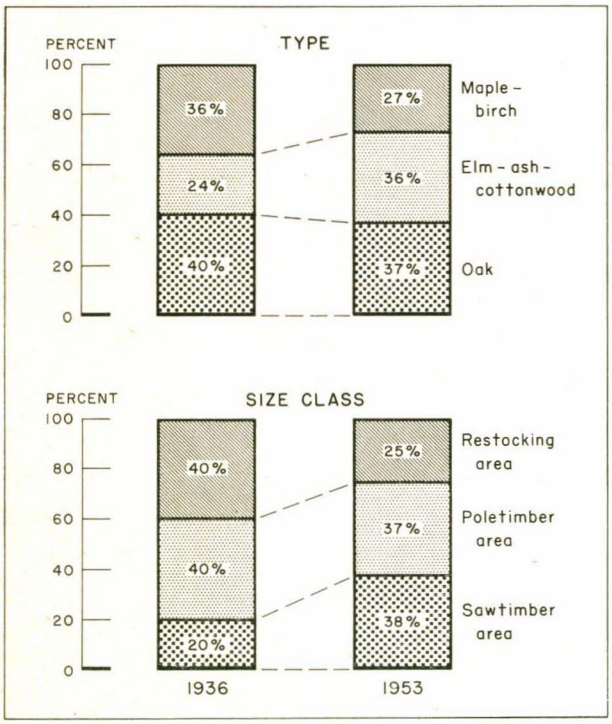

FIGURE 14.—*Changes in area of hardwood types between 1936 and 1953.*

Nonstocked Areas Still a Problem

A substantial increase in acreage of nonstocked forest lands is indicated, the 1953 survey showing almost 4,483,000 acres in a nonstocked condition as compared with 3,768,000 acres in 1936. A breakdown of these figures indicates that the area of deforested upland decreased from 1,887,000 acres to 1,748,000 acres. This is where the most planting has been done. At the same time, deforested swampland increased from 1,881,000 acres to 2,735,000.

Ownership Becoming More Stable

No radical change occurred in ownership of forest land between the two surveys. However, much progress was made in stabilizing control and improving management on the part of both public and private agencies. A large share of the lands that had reverted to public ownership for nonpayment of taxes now has been organized into State and county forests. Several industrial forests have been established. National forests and Indian forests have been rounded out somewhat by limited purchases and by exchanges with other landowners. Less change can be noted in the status of farm forests and the other lands in diverse small private ownership.

Timber Volumes

Small Share of Volume Is Sawtimber

The estimated volume of all timber on commercial forest land in Minnesota in 1953 was 8,939 million cubic feet (table 7). Of the total volume, 31 percent is in sawtimber trees and 50 percent in poletimber trees. Together these make up 7,235 million cubic feet, or about 5 cords per acre. About 19 percent is in cull trees and hardwood limbs (fig. 15). From a utilization standpoint, this latter volume is considered nonmerchantable and, as such, is not included in any estimate of allowable cut or actual timber cut. However, with the rapid strides in technology and increasing emphasis on cellulose forestry, at least some of this presently nonmerchantable material may in the future be of importance to Minnesota's wood-using industries.

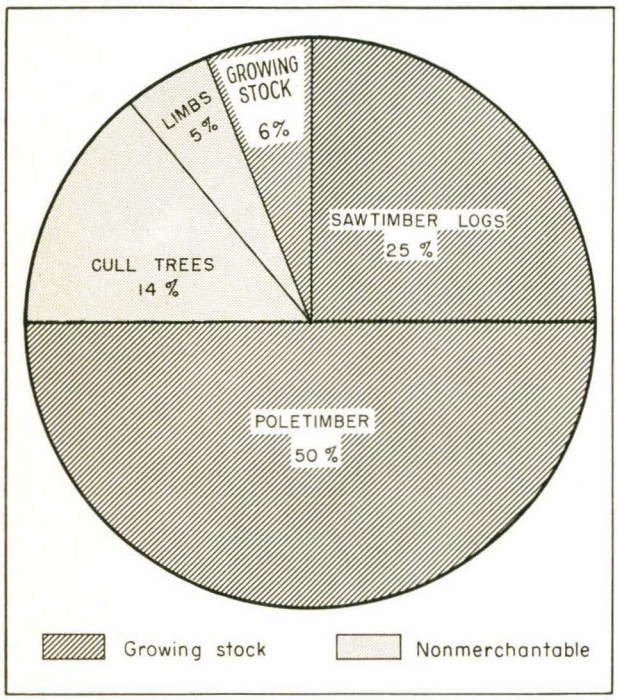

FIGURE 15.—*The percentage of volume of all live timber on commercial forest land in various kinds of material.*

Of the total growing stock, 39 percent is in softwood species and 61 percent in hardwood species. Most of the growing stock also is in the northeastern division. Pine and spruce account for most of the softwood volume (table 8). Aspen, oak, elm, and basswood are the most important hardwood species in the State.

TABLE 7.—*Net volume of all timber on commercial forest land, by class of material, geographic division, and species group, Minnesota, 1953*

Class of material	Total	Division			Softwoods	Hardwoods
		Northeastern	Southeastern	Western		
Growing stock:	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*
Sawtimber trees:						
Saw-log portion	2,228	1,488	528	212	905	1,323
Upper stem portion	519	361	113	45	230	289
Total	2,747	1,849	641	257	1,135	1,612
Poletimber trees	4,488	3,690	522	276	1,694	2,794
Total	7,235	5,539	1,163	533	2,829	4,406
Other material:						
Sound cull trees	180	-------	-------	-------	(1)	180
Rotten cull trees	1,073	-------	-------	-------	77	996
Total	1,253	1,053	125	75	77	1,176
Hardwood limbs	443	352	59	32	(1)	443
Salvable dead trees	8	8	(1)	(1)	4	4
Total	1,704	1,413	184	107	81	1,623
Total, all timber	8,939	6,952	1,347	640	2,910	6,029

[1] Negligible.

TABLE 8.—*Net Volume of live sawtimber and growing stock on commercial forest land, by species, Minnesota, 1953*

Species	Sawtimber	Growing stock
Softwoods:	*Million bd.-ft.*	*Million cu. ft.*
White pine	868	220
Red pine	850	235
Jack pine	1,420	771
Black spruce	363	579
White spruce	473	152
Balsam fir	504	441
Tamarack	166	218
Cedar	395	213
Total	5,039	2,829
Hardwoods:		
Sugar maple	261	124
Soft maples	104	45
Yellow birch	53	15
Basswood	833	297
Elm	1,167	353
Red oak	1,218	484
White oak	174	69
Other white oaks	540	217
Aspen	1,716	1,812
Balsam poplar	225	154
Cottonwood	211	50
Paper birch	405	416
Ash	462	306
Hickory	9	9
Black walnut	13	4
Other hardwoods	108	51
Total	7,499	4,406
All species	12,538	7,235

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The net volume of live sawtimber and growing stock on commercial forest land, by stand-size class, was as follows:

Stand-size class:	*Sawtimber* [1] *(million bd.-ft.)*	*Growing stock (million cu. ft.)*
Sawtimber stands	7,735	2,445
Poletimber stands	3,973	3,891
Seedling and sapling stands	781	875
Nonstocked and other areas not elsewhere classified	49	24
Total	12,538	7,235

[1] Sawtimber volumes, International ¼-inch rule.

Sawtimber of Rather Poor Quality

Softwoods make up 40 percent of the total sawtimber volume in the State, but vary from 59 percent in the northeastern division to 3 percent in the southeastern and 5 percent in the western divisions (table 9). Most of the sawtimber volume is in trees of relatively small diameter (table 10). When used for lumber such trees yield mainly common grades.

TABLE 9.—*Net volume of live sawtimber on commercial forest land, by species and geographic division, Minnesota, 1953*

Species	Total	Divisions		
		Northeastern	Southeastern	Western
	Million bd.-ft.	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*
Softwoods:				
White pine	868	831	32	5
Red pine	850	836	12	2
Jack pine	1,420	1,377	10	33
Black spruce	363	359	1	3
White spruce	473	466	5	2
Balsam fir	504	499	3	2
Tamarack	166	139	20	7
Cedar	395	394		1
Total	5,039	4,901	83	55
Hardwoods.				
Sugar maple	261	132	118	11
Soft maples	104	28	29	47
Yellow birch	53	51	2	
Basswood	833	236	466	131
Elm	1,167	304	563	300
Red oaks	1,218	140	1,017	61
White oak	174		166	8
Other white oaks	540	91	267	182
Aspen	1,716	1,630	61	25
Balsam poplar	225	195	6	24
Cottonwood	211		29	182
Paper birch	405	384	15	6
Ash	462	206	134	122
Other hardwoods	130	5	72	53
Total	7,499	3,402	2,945	1,152
All species	12,538	8,303	3,028	1,207

TABLE 10.—*Net volume of live sawtimber on commercial forest land, by diameter class and species, Minnesota, 1953*

Species	Volume when tree diameter class (inches) is—						
	10	12	14	16	18	20+	Total
	Million bd.-ft.	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*
Softwoods:							
White pine	120	166	129	98	81	274	868
Red pine	152	212	181	104	74	127	850
Jack pine	631	497	221	57	12	2	1,420
Black spruce	268	87	8				363
White spruce	143	139	99	44	26	22	473
Balsam fir	284	155	53	11	1		504
Tamarack	92	55	16	1	2		166
Cedar	169	152	50	17	4	3	395
Total	1,859	1,463	757	332	200	428	5,039
Hardwoods:							
Sugar maple		80	60	43	30	48	261
Soft maples		21	19	24	14	26	104
Yellow birch		14	11	9	6	13	53
Basswood		214	216	151	116	136	833
Elm		239	196	178	154	400	1,167
Red oak		405	341	222	129	121	1,218
White oak		63	45	30	17	19	174
Other white oaks		211	137	88	57	47	540
Aspen		1,018	409	170	72	47	1,716
Balsam poplar		133	51	35	6		225
Cottonwood		11	16	18	20	146	211
Paper birch		204	118	53	22	8	405
Ash		195	116	70	36	45	462
Hickory		4	3	1		1	9
Black walnut		2	2	2	7		13
Other hardwoods		45	27	18	11	7	108
Total		2,859	1,767	1,112	697	1,064	7,499
All species	1,859	4,322	2,524	1,444	897	1,492	12,538

With respect to hardwoods, more of the volume is in the larger trees. However, Minnesota is on the western fringe of the natural range of the maple-beech-birch type, and tree development is poor. Its oak forests, especially those of the savannah type along the prairie edge, support trees that are short, crooked, and limby (fig. 16). Its best quality hardwoods are on lowlands and coves adjacent to the Mississippi River and its tributaries.

Recent studies indicate that for the entire State, 67 percent of the merchantable hardwood sawtimber volume is in No. 3 or tie-and-timber log grade, mainly suitable for manufacture into box and crate material, pallets, dunnage, timbers, and rough lumber. Log grades No. 1 and No. 2, fit for sawing into standard lumber and other more specialized uses, make up the remaining 33 percent of the volume.

FIGURE 16.—*Oak forests cling to some of the poorer farmlands in the southeastern division and extend irregularly into the western division. Most of the oak timber is short and limby, usable mainly for low-grade lumber and railroad ties. (Photo courtesy Minnesota Conservation Department.)*

Smaller Timber Finds Many Uses

In Minnesota, much more timber is harvested for pulpwood than for lumber (fig. 17). Additional large volumes are cut for fuelwood, posts, mine timbers, etc. Thus the size of timber is not of limiting importance.

Pulpwood Volume Large

The volume of the principal pulping species [1] totals about 46,940,000 cords, mostly in the northeastern division (table 11).

Jack pine pulpwood aggregates 9,640,000 cords with 5,430,000 cords in 3 of the counties (Cook, Lake, and St. Louis Counties) in the extreme northeast corner of the State.

Spruce pulpwood volume is 9,140,000 cords and balsam fir 5,510,000 cords. Forty-seven percent of this spruce-fir volume is in the Superior District while an additional 29 percent is in the adjoining Rainy River District to the West.

Aspen pulpwood totals 22,650,000 cords, nearly all well distributed over the northern part of the State.

[1] Species included are jack pine, black spruce, white spruce, balsam fir, and aspen. Volumes include both poletimber and sawtimber of these species.

Federal Forests Include Much Softwood Timber

The Chippewa and Superior National Forests, with a combined area of 2,195,000 forested acres, have 1,367 million cubic feet of growing stock (table 12). Because the area includes many very young stands and some bog and rock outcrop, the overall average stocking is only 623 cubic feet (about 7.8 cords) per acre. More than 60 percent of this is softwood timber including 7½ million cords of pulpwood (table 13). Extensive areas of plantations and natural stands of seedlings and saplings are intermingled, and the whole is being managed for sustained yield.

TABLE 11.—*Location of pulpwood volume, by species, Minnesota, 1953*

Species	Total	North-eastern division	South-eastern division	Western division
	Thousand cords	*Thousand cords*	*Thousand cords*	*Thousand cords*
Softwoods:				
Jack pine	9,640	9,300	50	290
Spruce	9,140	8,890	50	200
Balsam fir	5,510	5,450	20	40
Total	24,290	23,640	120	530
Aspen	22,650	20,160	1,360	1,130
All pulp species	46,940	43,800	1,480	1,660

FIGURE 17.—*The leading forest product in Minnesota is pulpwood. Most pulpwood is cut in 100-inch lengths to a minimum top diameter of 4 inches.* (*Photo courtesy Minnesota & Ontario Paper Co.*)

TABLE 12.—*Net volume of all growing stock, sawtimber, and poletimber on commercial forest land, by ownership class and species group, Minnesota, 1953*

Ownership class	All growing stock			Sawtimber			Poletimber		
	Total	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total	Softwoods	Hardwoods
	Million cu. ft.	*Million cu. ft.*	*Million cu. ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Thousand cords*	*Thousand cords*	*Thousand cords*
Federally owned or managed:									
National forest	1,367	812	555	2,433	1,727	706	10,300	5,300	5,000
Indian	348	156	192	489	249	240	3,000	1,260	1,740
Bureau of Land Management	16	12	4	23	19	4	130	90	40
Other	38	7	31	66	12	54	300	60	240
Total	1,769	987	782	3,011	2,007	1,004	13,730	6,710	7,020
State	1,213	723	490	1,688	1,024	664	10,440	6,130	4,310
County or municipal	1,070	396	674	1,391	667	724	9,540	3,080	6,460
Private:									
Farm	1,992	251	1,741	4,485	439	4,046	12,920	1,910	11,010
Industrial and other	1,191	472	719	1,963	902	1,061	9,480	3,360	6,120
Total	3,183	723	2,460	6,448	1,341	5,107	22,400	5,270	17,130
All ownerships	7,235	2,829	4,406	12,538	5,039	7,499	56,110	21,190	34,920

TABLE 13.—*Ownership of pulpwood volume, Minnesoto, 1953*

Ownership class	Total State	All growing stock	
		Softwoods [1]	Hardwoods [2]
	Thousand cords	*Thousand cords*	*Thousand cords*
Federally owned or managed:			
National forest	11,670	7,490	4,180
Indian	2,610	1,230	1,380
Other Federal	290	160	130
Total	14,570	8,880	5,690
State	9,860	6,590	3,270
County and municipal	8,070	3,170	4,900
Private:			
Farm	6,240	1,870	4,370
Industrial and other	8,200	3,780	4,420
Total	14,440	5,650	8,790
All ownerships	46,940	24,290	22,650

[1] Includes total merchantable volume of jack pine, black spruce, white spruce, and balsam fir, expressed in standard cords.

[2] Aspen only.

Indian forest lands and certain other federally controlled lands aggregating 860,000 acres have 402 million cubic feet of growing stock, or an average of 467 cubic feet per acre (about 5.8 cords). They support a smaller proportion of softwoods than the national forests. Most of the areas are in fairly good condition for management, however.

State Controls Valuable Pulpwood Stands

The State with 3,484,000 acres of forest land has a volume of 1,213 million cubic feet of growing stock or an average of 348 cubic feet or 4.4 cords per acre. It has relatively little sawtimber—less than 500 board-feet per acre average—but it has 6.6 million cords of valuable softwood pulp timber, mainly spruce and balsam fir.

Counties Control Significant Volumes

The recent survey disclosed that the counties had larger and more valuable timber stands than was previously realized (fig. 18). On a total area of 3,619,000 acres, they have 1,070 million cubic feet. This gives an average of 296 cubic feet (3.7 cords) per acre, even though most of the lands were cut over just before coming under county control.

County lands have less softwood volume than Federal or State forests and have a comparatively low saw-log volume. However, they do have 3.2 million cords of softwood pulpwood and 4.9 million cords of aspen pulpwood, and they have extensive acreages of young timber suitable for management.

Farm Woods Are Primarily Hardwood

Some 1,992 million cubic feet of timber is growing on 4,881,000 acres of farm woods—an average stand of 408 cubic feet (5.1 cords) per acre (fig. 19). Seven-eighths of this volume is hardwood. Sawtimber volume (90 percent hardwood) averages 920 board-feet per acre, which is higher than for any other owner group. Pulpwood volume averages 1.3 cords per acre and is mostly aspen.

FIGURE 18.—*A Clearwater County forester marks a fire-scarred tree for removal in a stand-improvement operation. Minnesota counties own significant acreages of young timber suitable for management. (Photo courtesy Iron Range Resources and Rehabilitation Commission.)*

Other Privately Owned Timber of Mixed Character

About 1,191 million cubic feet is growing on 3,059,000 acres of private land other than farms. This gives an average of 390 cubic feet (4.9 cords) per acre. Sixty percent of the volume is hardwood. The average volume per acre of sawtimber is 640 board-feet (54 percent hardwood), of pulpwood 2.7 cords (54 percent aspen).

Hardwood Volumes Have Increased

Timber volumes as a whole are greater now than in 1936—growing stock by 13 percent and sawtimber by 11 percent. However, the volume of softwood timber has declined. Growing stock volumes of white pine, red pine, jack pine, and the spruces all show substantial reductions offset only partially by increases in volume of balsam fir and tamarack. Reduction in softwood sawtimber volume is even more pronounced. The present volume of 5.0 billion board-feet is 20 percent below the 1936 estimate. Again the decline is found in the more valuable pines and spruces (fig. 20).

A comparison of 1936 and 1953 estimates of timber volume on commercial forest land, by species group, follows:

	1936	*1953*
All growing stock:	*Million cu. ft.*	*Million cu. ft.*
Softwoods	3,027	2,829
Cottonwood-aspen	1,514	1,862
Other hardwoods	1,879	2,544
Total	6,420	7,235
Sawtimber volume:	*Million bd.-ft.*	*Million bd.-ft.*
Softwoods	6,300	5,039
Cottonwood-aspen	1,630	1,927
Other hardwoods	3,320	5,572
Total	11,250	12,538

Opposing this decline in softwoods has been the rise in hardwood volumes. Both growing stock and sawtimber volumes are greater now than in 1936—growing stock by 30 percent and sawtimber by 51 percent. Although practically all hardwoods have increased to some extent, the largest gains in volume have been in the elms, oaks, basswood, and aspen.

Undoubtedly, the average quality of sawtimber has declined between surveys. Changed grading standards make direct comparison impractical, but comparison can be made on the basis of tree size. The proportion of total volume in the larger diameters, 19 inches and over, declined about one-half between 1936 and 1953. This trend helps to explain why two-thirds of the present hardwood volume is in No. 3 or tie-and-timber log grade.

A comparison of 1936 and 1953 estimates of diameter-class distribution for all merchantable hardwood sawtimber follows:

Diameter class (inches):	*1936 (percent)*	*1953 (percent)*
11.0–14.9	48	62
15.0–18.9	26	24
19.0 and up	26	14

Net Annual Growth

Table 14 shows the estimated rate of annual growth by species while table 15 separates the group totals among the major divisions of the State.

TABLE 14.—*Net annual growth, by species, of all growing stock, sawtimber, and poletimber on commercial forest land, Minnesota, 1953*

Species	All growing stock	Sawtimber	Poletimber
	Million cu. ft.	*Million bd.-ft.*	*Thousand cords*
Softwoods:			
White pine	6.9	30.2	−0.1
Red pine	8.2	37.2	−4.6
Jack pine	15.1	83.9	−62.9
Black spruce	22.8	37.7	171.3
White spruce	4.9	19.9	4.5
Balsam fir	37.7	78.2	236.3
Tamarack	13.3	22.3	99.4
Cedar	8.7	19.3	51.1
Total	117.6	328.7	495.0
Hardwoods:			
Sugar maple	5.9	9.5	46.8
Soft maples	1.3	.8	14.4
Yellow birch	.3	1.2	.5
Basswood	13.2	41.7	47.4
Elm	11.7	47.1	17.2
Red oaks	17.1	58.4	53.2
White oak	2.0	8.1	2.9
Other white oaks	9.5	30.3	35.2
Aspen	147.0	170.4	1,357.9
Balsam poplar	11.8	18.5	96.8
Cottonwood	.7	3.0	1.0
Paper birch	24.7	23.7	241.5
Ash	15.4	36.0	94.0
Other hardwoods	6.4	10.7	50.4
Total	267.0	459.4	2,059.2
All species	384.6	788.1	2,554.2

TABLE 15.—*Net annual growth of sawtimber and all growing stock on commercial forest land, by species group and geographic division, Minnesota, 1953*

Species group	Total	Division		
		North-eastern	South-eastern	Western
	Million cu. ft.	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*
Growing stock:				
Softwoods	117.6	114.7	1.2	1.7
Aspen [1]	158.8	138.9	9.0	10.9
Other hardwoods	108.2	58.2	37.8	12.2
Total	384.6	311.8	48.0	24.8
	Million bd.-ft.	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*
Sawtimber:				
Softwoods	328.7	317.6	5.0	6.1
Aspen [1]	188.9	163.5	12.3	13.1
Other hardwoods	270.5	99.5	123.6	47.4
Total	788.1	580.6	140.9	66.6

[1] Includes balsam poplar but not cottonwood.

Rate Has Increased Since 1936

Annual growth in terms of total growing stock increased from 278 million cubic feet in 1936 to 384.6 million cubic feet in 1953, an increase of 38 percent. Sawtimber growth increased 84 percent. The increase in total volume was greater in hardwoods than in softwoods (table 16 and fig. 21).

TABLE 16.—*Comparison of 1936 and 1953 annual net growth of sawtimber and growing stock, by species group, Minnesota*

Species group	All growing stock		Sawtimber	
	1936	1953	1936	1953
	Million cu. ft.	*Million cu. ft.*	*Million bd.-ft.*	*Million bd.-ft.*
Softwoods	99.0	117.6	191.0	328.7
Aspen [1]	102.1	158.8	112.9	188.9
Other hardwoods	76.9	108.2	125.1	270.5
Total, all species	278.0	384.6	429.0	788.1

[1] Includes balsam poplar but not cottonwood.

Further Large Increases Possible

Minnesota forest lands are capable of growing vastly more timber than is now being produced. Possible timber volumes and growth rates attainable in 1965 and 1975 are shown in table 17.

TABLE 17.—*Minnesota's potential timber volume and net growth in 1965 and 1975 under certain assumptions as to increases in future timber requirements and continuing progress in forestry* [1]

Class of material and species group	Timber volume			Annual net growth		
	1953	1965	1975	1953	1965	1975
	Million cu. ft.	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*
All growing stock:						
Softwoods	2,829	3,550	4,200	117.6	136.3	153.9
Hardwoods	4,406	5,832	6,978	267.0	303.5	327.9
Total	7,235	9,382	11,178	384.6	439.8	481.8
	Million bd.-ft.	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*
Sawtimber only:						
Softwoods	5,039	6,934	8,875	328.7	391.2	450.0
Hardwoods	7,499	10,085	12,428	459.4	546.9	617.0
Total	12,538	17,019	21,303	788.1	938.1	1,067.0

[1] The outlook for timber volumes and net annual growth in 1965 and 1975 is based on assumptions that the annual timber products output in the United States and Minnesota will rise with estimated increases in population, national income and the position of wood in the national economy. Also, that forestry will continue to progress at the rate indicated by recent trends, including advances in protection, management, and reforestation. These projections were developed from trends for the entire Lake States as prepared for the upper level of future timber requirements shown in the preliminary review draft of the Timber Resource Review. These trends are predicated upon anticipated future timber-product demands on the Lake States forests, a continuing pattern of reforestation of denuded lands, a "thickening up" of natural stands, and other changes leading to a more productive forest resource.

Naturally such projections are speculative not only because of uncertainty as to management practices of landowners, uncertainty as to future utilization, but also because of still incomplete knowledge of forest type behavior under all kinds of treatment. Much of the Lake States forest area is covered by temporary and changing forest types whose future composition cannot yet be accurately foretold.

FIGURE 19.—*Farm woods are mainly hardwood. They contain many trees of poor form and poor vigor that should be utilized or destroyed to stimulate growth of more healthy and more valuable timber. (Photo courtesy Minnesota Conservation Department.)*

Nonstocked Acreage Reduces Growth Total

The possible future increases in growth calls attention to certain inadequacies in the present growth situation. One of these is the large nonstocked acreage. The average annual growth per acre on land actually supporting timber is 28 cubic feet with 58 board-feet of sawtimber included. This falls to 21 cubic feet with 44 board-feet of sawtimber when applied to total forest area with its interspersed nonstocked land.

High Mortality a Retarding Factor

In 1953, the annual loss of merchantable timber from fire, wind, insects, disease, and miscellaneous natural causes was estimated to be 194 million board-feet of sawtimber and 173 million cubic feet of all growing stock:

Species:	*All growing stock (million cu. ft.)*	*Sawtimber (million bd.-ft.)*
Softwoods:		
White, red, and jack pine	28	52
Spruce and balsam fir	29	26
Other softwoods	11	10
Total	68	88
Hardwoods:		
Hard hardwoods	20	33
Aspen	59	42
Other soft hardwoods	26	31
Total	105	106
All species	173	194

This annual loss amounts to 2.4 percent of the growing stock and 1.5 percent of the sawtimber volume. It is 45 percent as large as the annual growth for all growing stock and about 25 percent of the sawtimber growth (fig. 22).

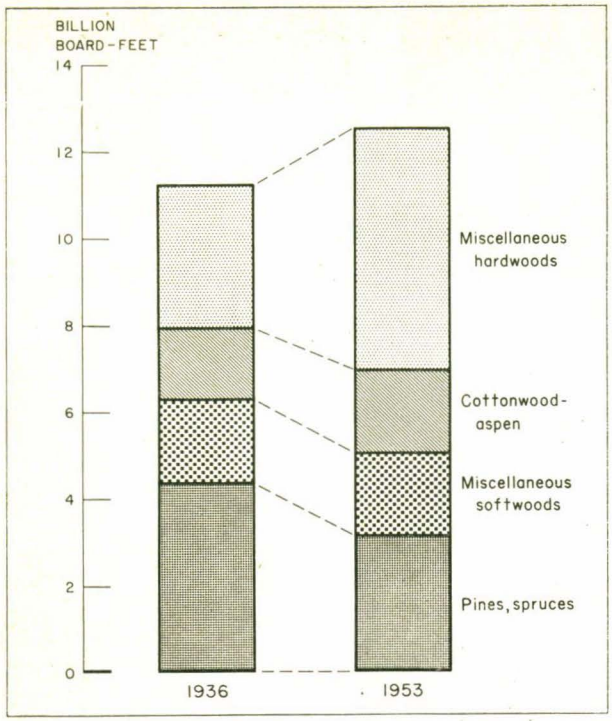

FIGURE 20.—*Volume of live sawtimber on commercial forest land by major species groups, 1936 and 1953.*

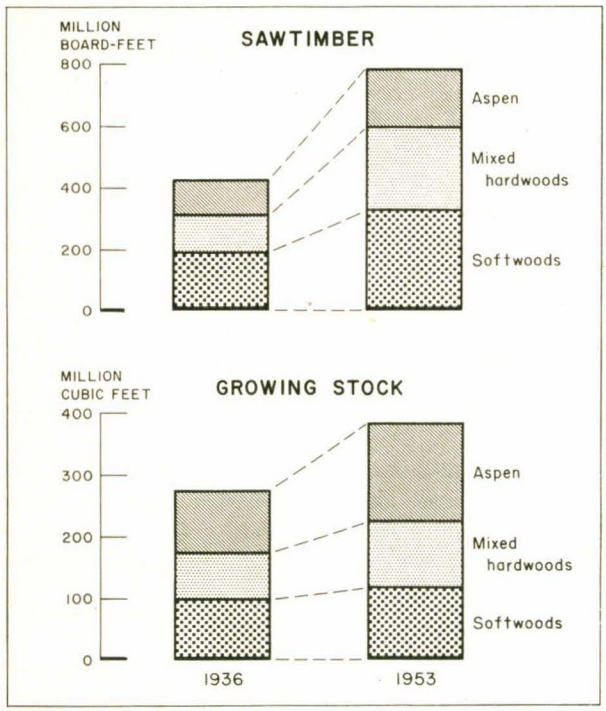

FIGURE 21.—*Comparison of annual net growth for sawtimber and all growing stock, 1936 and 1953.*

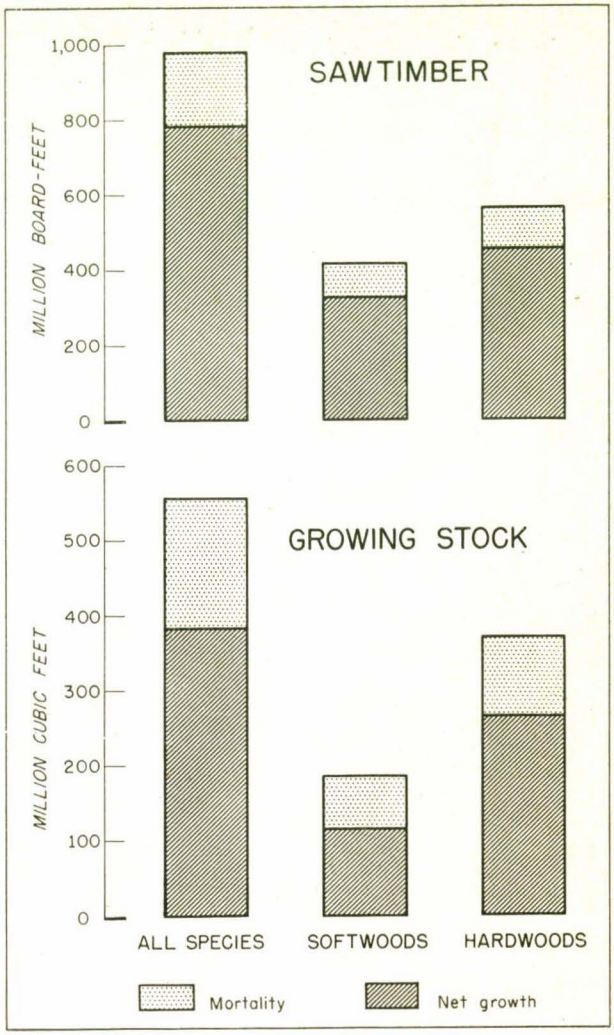

FIGURE 22.—*Annual mortality and net growth for sawtimber and all growing stock.*

Fire, which in earlier years was one of the leading destroyers of timber, now has been brought under better control (fig. 23). The average annual acreage burned in Minnesota for 1931–35 was 476,070 acres, while for 1948–52 it was 103,230 acres. A program for educating the public to the wanton waste in wildfires, together with improved organization for fire protection and suppression, has accomplished the reduction.

Windstorms, disease, fires, and insects not only kill many trees but they lower the quality of the remaining trees and gradually render them unfit for commercial use. These losses can be reduced greatly by improved forest management and timely utilization.

FIGURE 23.—*Dousing a peat fire with water. In recent years, because prevention and protection have been stepped up, forest fires are no longer the leading cause of timber mortality in Minnesota. Windstorms and disease now destroy more merchantable timber than fire does in a typical year (Photo courtesy Minnesota Conservation Department).*

Current Growth Mainly On Small Trees

Although sawtimber growth increased considerably between 1936 and 1953, it is significant that the bulk of this growth is on trees of very small diameter. Approximately two-thirds of the total consists of "ingrowth," i. e., board-foot volume credited to trees that pass from poletimber-size to minimum sawtimber-size (9 inches d. b. h. for softwoods, 11 inches d. b. h. for hardwoods). The other one-third of growth is spread over larger trees. Probably less than 3 percent accumulates on trees 20 inches or larger d. b. h.

In poletimber stands likewise, the greater part of the growth is "ingrowth" into the 6-inch diameter class.

Before the forests can yield in reasonably large quantities the sizes and grades of logs and bolts preferred by industries, it will be necessary to build up the growing stock.

Growth Contains Too Little Softwood

Eight million acres of Minnesota forest lands are well adapted to the production of softwood timber, but only 4½ million acres are occupied by softwood types at present. With reasonable protection and care, the existing stands and areas that will restock naturally may produce 30 percent more softwood growth by 1975 and, with a modest planting program, can yield at least twice as much eventually.

Quality of Hardwood Growth Needs Improvement

With such a large share of the growth accumulating on trees of small size and on trees of inferior quality,

it is apparent that current growth of hardwoods is not of high average value. Opportunities exist to improve this situation by allowing growth to accumulate for a period of years so that stands will have more large-size trees on which new wood can be added. Further improvement can be accomplished by making frequent light cuttings to remove cull trees, weed trees, and others unduly exposed to mortality. Fencing out livestock often will help.

Allowable Cut

Cut Should Be Less Than Growth

If the aim is to obtain larger and more valuable yields in the future, the current annual harvest of timber for lumber, pulpwood, fuel, etc., should not exceed about two-thirds of the annual growth according to calculations made during the survey.[2]

Current allowable cut for all growing stock is estimated to be 247.0 million cubic feet including 523.8 million board-feet of sawtimber (table 18). Sixty-one percent of the cubic foot figure represents hardwood species.

Of the estimated allowable cut of sawtimber, 78 percent is in the northeastern division (97 percent of the softwood, 64 percent of the hardwood) (table 19).

For the principal pulpwood species the annual allowable cut totals 2,040,000 cords, practically all of which is in the northeastern division (table 20).

Trends in Allowable Cut Upward

Comparison of allowable cut estimates for 1936 and 1953 shows substantial increases for both sawtimber and total growing stock (fig. 24).

[2] Allowable cut is the volume of merchantable live sawtimber and poletimber that can be cut during a given period while building up or maintaining sufficient growing stock to meet specified growth goals. Several factors including distribution of forest areas by types, species composition, and size classes, together with the less tangible factors of operability and market demand, influence the determination of annual allowable cut. Because of the variable conditions encountered in statewide inventory sampling, all factors that would actually determine allowable cut on a managed forest could not be applied. But in order to be as realistic as possible, field crews judged sampled stands for allowable cut about as they would for a prospective timber sale, weighing operability as well as silvicultural factors. For the northeastern division, a stand was not judged operable unless the timber available for cutting exceeded 1,500 board-feet per acre of sawtimber, or 3 cords per acre for pulpwood cuts. In the southern districts where stands are more accessible, the minimum operable cuts considered were 500 board-feet per acre for sawtimber and 1 cord per acre for cordwood.

TABLE 18.—*Annual allowable cut of all growing stock, sawtimber and poletimber on commercial forest land, by species, Minnesota, 1953*

Species	All growing stock	Sawtimber	Poletimber
	Million cu. ft.	*Million bd.-ft.*	*Thousand cords*
Softwoods:			
White pine	6.0	25.0	9
Red pine	5.3	21.8	8
Jack pine	29.7	83.3	131
Black spruce	18.3	17.2	176
White spruce	6.8	23.9	18
Balsam fir	18.0	30.2	136
Tamarack	5.1	7.0	43
Cedar	6.3	14.9	36
Total	95.5	223.3	557
Hardwoods:			
Sugar maple	2.5	6.8	13
Soft maples	1.2	3.2	6
Yellow birch	.4	1.9	1
Basswood	6.2	23.2	16
Elm	8.2	32.5	19
Red oaks	9.4	28.9	41
White oak	1.0	4.1	2
Other white oaks	3.7	12.3	14
Aspen	90.4	133.5	757
Balsam poplar	4.6	10.7	28
Cottonwood	1.2	5.4	----
Paper birch	16.4	23.0	142
Ash	5.3	12.1	34
Other hardwoods	1.0	2.9	3
Total	151.5	300.5	1,076
All species	247.0	523.8	1,633

TABLE 19.—*Annual allowable cut of sawtimber and all growing stock on commercial forest land, by species group and geographic division, Minnesota, 1953*

Class of material and species group	Total	Division		
		Northeastern	Southeastern	Western
Growing stock:	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*
Softwoods	95.5	93.0	1.0	1.5
Aspen	95.0	81.0	7.5	6.5
Other hardwoods	56.5	31.4	17.7	7.4
Total	247.0	205.4	26.2	15.4
Sawtimber:	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*
Softwoods	223.3	216.8	3.0	3.5
Aspen	144.2	133.6	6.8	3.8
Other hardwoods	156.3	59.3	67.7	29.3
Total	523.8	409.7	77.5	36.6

In sawtimber the annual allowable cut for white pine, red pine, and spruce changed very little from that recommended in 1936; that for aspen, oak, elm, and basswood, however, increased greatly.

TABLE 20.—*Annual allowable cut of principal pulpwood species, by geographic division, Minnesota, 1953*

Species	Total	North-eastern division	South-eastern division	Western division
	Thousand cords	*Thousand cords*	*Thousand cords*	*Thousand cords*
Softwoods:				
Jack pine	371	357	3	11
Spruce	314	310	----------	4
Balsam fir	225	224	1	----------
Total	910	891	4	15
Aspen	1,130	965	92	73
All pulp species	2,040	1,856	96	88

In total growing stock, the allowable cut estimate was higher in 1953 for all species groups (table 21).

TABLE 21.—*Comparison of 1936 and 1953 annual allowable cut on commercial forest land, by species group, Minnesota*

Species group	Sawtimber		All growing stock	
	1936 [1]	1953	1936 [1]	1953
	Million bd.-ft.	*Million bd.-ft.*	*Million cu. ft.*	*Million cu. ft.*
Softwoods	195.2	223.3	48.7	95.5
Aspen [2]	87.5	144.2	71.6	95.0
Other hardwoods	80.9	156.3	36.9	56.5
Total	363.6	523.8	157.2	247.0

[1] 1936 original figures adjusted to current survey standards of measure.
[2] Includes balsam poplar.

Changes in allowable cut are not dependent entirely upon changes in the forest itself. Inevitably they are influenced also by economic considerations. The 1953 estimate reflects considerable improvement in the market demand and consequently closer utilization than for the depression years when the previous estimate was made. In other words, coming in a more favorable economic period, and after substantial improvements have been made in transportation systems, logging methods, and management practices, the estimate includes a more optimistic appraisal of what can be cut practicably.

If growth trends continue upward into the future as a result of improved forestry practices, allowable cut should rise likewise until eventually it will equal growth. Conservative projections indicate the possibility of increasing the cut by more than 50 percent before the end of the century.

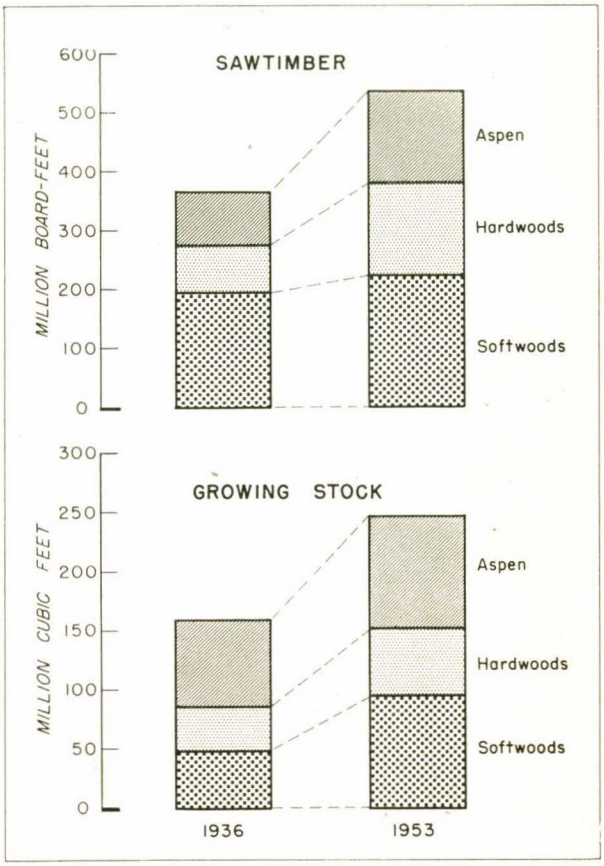

FIGURE 24.—*Comparisons of annual allowable cut for sawtimber and all growing stock, 1936 and 1953.*

Forest Industries and Their Wood Needs

Where the Timber Goes

LARGE QUANTITIES OF TIMBER are cut each year for use in Minnesota processing plants. Some additional volume is shipped to mills in adjacent States. Large amounts are cut and used for fuelwood, posts, and other round timber items. Finally, a limited quantity is left in the woods or along routes of transport in the form of residues.

Many Mills in State

Almost 2,000 primary wood-uslng plants operated in Minnesota in 1953. Nearly all were small sawmills and other small-scale enterprises; less than one percent were large industrial plants. More than one-half of the plants were in the northeastern division (table 22).

TABLE 22.—*Number of primary wood-using plants by geographic division, Minnesota, 1953*

Kind of mill	Total	Division		
		North-eastern	South-eastern	Western
Sawmills:				
Large [1]	3	3	0	0
Medium [2]	93	70	19	4
Small [3]	1,719	963	456	300
Total	1,815	1,036	475	304
Pulp mills	9	6	3	0
Veneer plants:				
High-grade	1	1	0	0
Container	8	0	7	1
Cooperage	1	0	1	0
Miscellaneous:				
Match	1	1	0	0
Clothespin	1	1	0	0
Lath-shingle	25	21	4	0
Total	1,861	1,066	490	305

[1] Annual production 5 million bd.-ft. or more.
[2] Annual production 500,000 to 4,999,000 bd.-ft.
[3] Annual production less than 500,000 bd.-ft.

Sawmills Are Small

Only 3 sawmills were classified in 1953 as large mills (producing 5 million board-feet or more). Typical of these is the Red Lake Indian Mills at Redby, Minn. (fig. 25). The medium and small mills are mostly circular-saw mills, gas or diesel operated, with output ranging from 1,000 to 25,000 board-feet per day. Only 1 mill in 5 has an edger or surfacing unit. Many of the small mills are moved once to several times a year. These mills operate on a seasonal schedule from late fall to late spring. They use from 5 to 25 men, the number depending on whether the service is strictly one of milling or a combination of logging and manufacture. During a normal year only about 75 percent of the mills are actively engaged in sawing; the remaining 25 percent are idle for one reason or another (fig. 26).

A recent survey showed that more than one-third of the sawmill operators sawed primarily for their own use; about one-third operated on a custom or contract basis processing logs for their neighbors; fewer than one-third sawed for commercial distribution or factory use.

Sawmills turned out an estimated 191,250,000 board-feet of lumber during 1953. This required removing only 150,248,000 board-feet of standing sawtimber (including logging residues) inasmuch as a large volume was sawed from material classified by inventory standards as poletimber (i. e., smaller than normal saw-log size). About 1½ percent was sawed from dead trees, cull trees, and other salvage material.

The 1953 cut of saw logs removed 36,374,000 cubic feet of growing stock (sawtimber and poletimber trees combined). This was 24 percent of the cut for all products. Half the volume removed was softwoods; half was aspen and other hardwoods.

The largest share—about 75 percent—of the lumber produced in 1953 was sawed in the northeastern division (fig. 27).

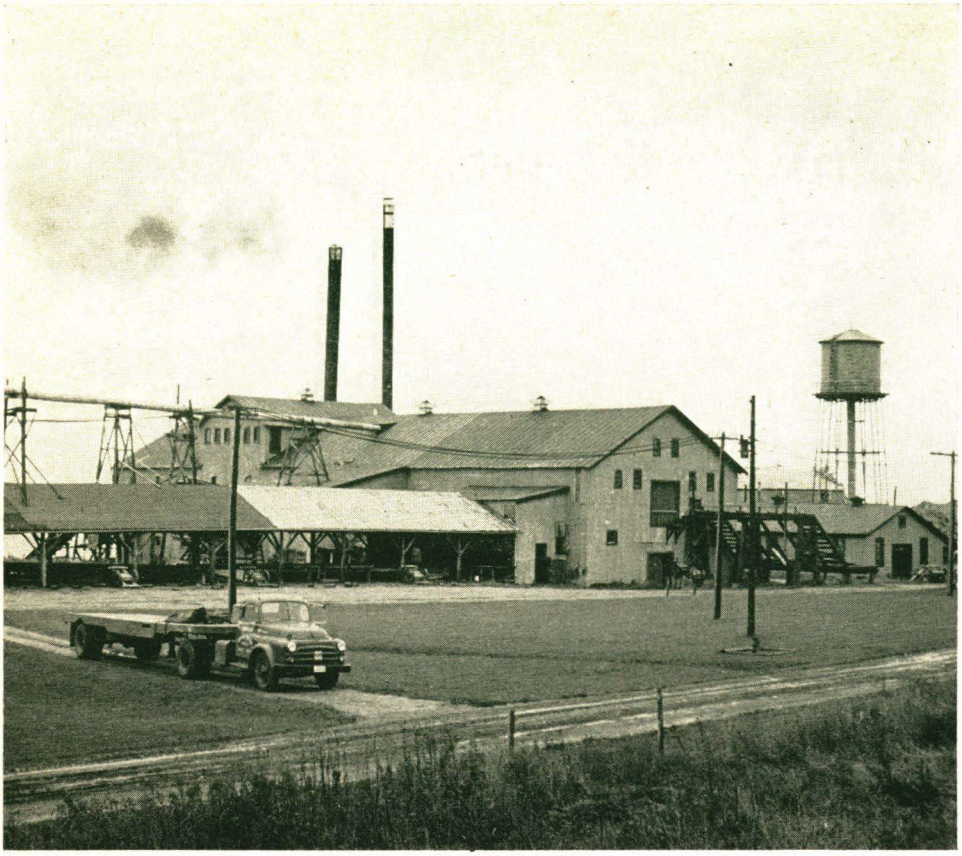

FIGURE 25.—*One of the largest mills in the State is the Red Lake Indian Mills at Redby. It is an 8-foot band mill with a 6-foot horizontal resaw, 66-inch double edger and trimmer. Auxiliary units consist of a planing mill, lath mill, fishbox factory, and electric-power generator for the local community. The mill organization markets all the lumber, boxes, cedar posts, poles, and pulpwood produced on the Red Lake reservation.*

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FIGURE 26.—*A typical northern Minnesota sawmill. Mills of this type produce most of Minnesota's lumber, largely from second-growth timber.*

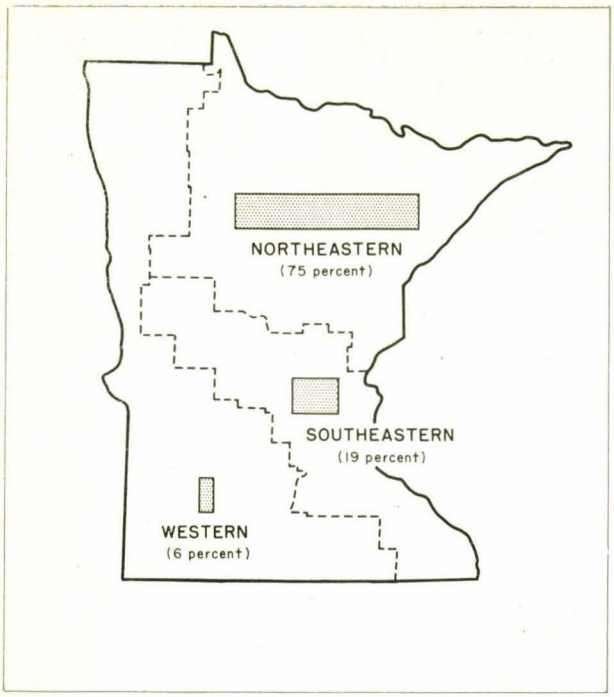

FIGURE 27.—*Where lumber was produced in 1953. Nearly all lumber sawed in the southern part of the State was hardwood; in the north, hardwoods including aspen made up about 40 percent of the cut.*

Nine Pulp Mills in 1953

Nine pulp mills produced about 400,000 tons of paper products, employed an estimated 8,000 persons, exclusive of woods workers (fig. 28), and turned out products worth about $110 million.

The plants at Brainerd, Grand Rapids, Little Falls, and Sartell are groundwood mills, and the pulp goes mainly into printing, writing, drawing, and hanging papers. One mill at Cloquet and one at International Falls (fig. 29) use both mechanical and chemical (principally sulfite) processes, the output going into a wide variety of papers.

A second mill at Cloquet and one at International Falls grind wood for building board and several types of cushioning or insulating felts. A mill at St. Paul pulps hardwoods by a semichemical process for use in manufacture of boxboard. A board mill at Duluth uses mechnical means to fiberize the wood, with the product going into hardboard.

The estimated cut of pulpwood in 1953 was equivalent to 74,602,000 cubic feet of growing stock, which is 48 percent of the total removed for all products. Only 12 percent of the timber cut for pulp was of saw-log size, while approximately 5 percent was obtained from limbs, cull trees, and other forms of salvage.

About 70 percent of the pulpwood cut was from softwood growing stock, 30 percent from hardwoods, primarily aspen. Most was cut in the northeastern division (fig. 30).

Approximately two-thirds of the pulpwood harvested was consumed in Minnesota mills. The remaining one-third went to Wisconsin and Michigan (fig. 31). On the other hand, Minnesota mills obtained a substantial amount of pulpwood from Canada, so total consumption was equivalent to about 80 percent of production.

Few Veneer Mills in State

The veneer industry is relatively small in Minnesota. Of 9 mills, only 1 at Grand Rapids is engaged in making better grades of veneer. The other eight, mostly in the southern part of the State, peel local hardwoods for cheese and berry boxes, egg crates, and bee supplies.

About 8 million board-feet of veneer logs and 1,000 cords of heading stock were cut in Minnesota in 1953. One-fourth was consumed by local mills while three-fourths was shipped to mills outside the State, primarily in Wisconsin and Michigan. About 90 percent of the veneer logs cut came from farm woodlands in the southeastern and western divisions. Approximately 75 percent of the veneer logs produced went to standard veneer mills in the Lake States region, and 25 percent to container mills. Nearly all of the veneer logs were hardwood, a few hundred board-feet of white pine being the only softwood included. Basswood was the leading species with 38 percent of the total veneer log production. Other species used were elm, cottonwood, maple, oak, and birch.

Other Mills Mainly Lath and Shingle

One cooperage plant, one match and clothespin factory, and 25 lath and shingle mills completed the list of primary wood-using plants found in 1953 (figs. 32 and 33). These plants used nearly 3 million cubic feet of wood in 1953. Aspen and paper birch were the species most widely used.

Much Wood Goes for Fuel

More wood was cut for fuel in 1953 than for any other product. The estimated fuelwood cut of 82.7

FIGURE 28.—*Cutting of pulpwood gives seasonal employment to thousands of men in Minnesota. Most spruce is cut during the winter months and hauled out of the swamps before the spring "breakup," which usually occurs early in April. (Photo courtesy Minnesota & Ontario Paper Co.)*

million cubic feet (1,197,000 cords), although less than half the quantity used at the time of the previous survey, was 42 percent of the cut of all products combined (table 23). However, 52.9 million cubic feet or 64 percent of the fuelwood was from nongrowing stock material such as cull trees, dead trees, and limbwood (fig. 34). The net removal of growing stock was 29.8 million cubic feet, less than that for either lumber or pulpwood.

Farmers cut about 70 percent of the fuelwood, using sizeable quantities of dead and defective timber as well as some sound trees of various sizes obtained in connection with land clearing.

Resort people, loggers, and other forest residents not living on farms cut about 15 percent of the fuelwood. Sawmills and other wood-using plants produced an equivalent quantity in the form of sawdust, shavings, slabs, edgings, and other mill residues.

Other Timber Used in Round Form

About 7,800,000 fence posts were cut by farmers and commercial loggers in 1953. Approximately 80 percent was cut from farm woodlands. Oak posts made up about 60 percent of the total cut, cedar about 20 percent, tamarack 12 percent, pine, aspen, and miscellaneous species 8 percent. A fairly high percentage of the posts was cut from material classed as nongrowing stock such as limbwood, trees less than 5 inches in diameter at breast height, and dead trees.

Cutters produced about 136,000 poles in 1953. About 80 percent of the poles was cedar, and 20 percent jack pine, red pine, and tamarack. Most of the poles were small: The cedar averaged about 25 feet long with a top diameter of about 5 inches, and pine 35 feet long with a top diameter of 7 inches.

Of the 7,200 pieces of piling (216,000 linear feet) produced in 1953, about 50 percent was red pine, 46 percent jack pine, and the remaining 4 percent white pine, tamarack, and elm. The softwood piling averaged about 30 feet long with a butt diameter of 13 inches and a top diameter of 9 inches.

Local mines took about 1,893,000 cubic feet of round and split wood. About half was of small log size used for timbers, cribbing, and trestle logs; the other half was smaller pieces used as mine poles and lagging.

TABLE 23.—*Output of timber products and annual cut of live sawtimber and growing stock, Minnesota, 1953*

Timber product	Output of timber products					Annual cut of sawtimber			Annual cut of growing stock		
	Volume in standard units		Roundwood volume			Total	Softwood	Hardwood	Total	Softwood	Hardwood
	Unit	Number	Total	Softwood	Hardwood						
			Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand bd.-ft.*	*Thousand bd.-ft.*	*Thousand bd.-ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Saw logs and saw bolts	M bd.-ft.[1]	191,250	31,188	16,401	14,787	150,200	84,800	65,400	36,400	18,250	18,150
Veneer logs and bolts	do	8,000	1,147	1	1,146	8,400		8,400	1,450		1,450
Cooperage logs and bolts	do	18	3		3						
Pulpwood	Std. cds.[2]	[3] 936,743	72,518	51,665	20,853	49,700	39,600	10,100	74,600	51,700	22,900
Fuelwood	do	1,197,000	82,707	12,455	70,252	27,800	1,800	26,000	29,800	2,750	27,050
Excelsior	do	692	54		54				50		50
Piling	M linear ft	216	152	152		1,200	1,200		200	200	
Poles	M pieces	136	1,158	1,158		3,700	3,700		1,450	1,450	
Posts	do	7,769	5,850	1,970	3,880	4,700	1,600	3,100	5,000	1,600	3,400
Hewn ties	do	[4]									
Mine timbers	M cu. ft	1,893	1,893	1,725	168	4,700	4,000	700	1,800	1,600	200
Miscellaneous [5]	do	2,582	2,582	370	2,212	11,300	1,400	9,900	3,450	450	3,000
Total			199,252	85,897	113,355	261,700	138,100	123,600	154,200	78,000	76,200

[1] International ¼ inch rule.
[2] Rough wood basis.
[3] Volume of wood from mill residues used for pulp is negligible.
[4] Negligible—included with miscellaneous products.
[5] Includes match and clothespin stock, hewn ties, cabin logs, lath, shingles, etc.

FIGURE 29.—*The Minnesota & Ontario Paper Co. mill at International Falls is one of several mills that has increased its annual output of pulp and paper products through greater use of aspen. (Photo courtesy Minnesota & Ontario Paper Co.)*

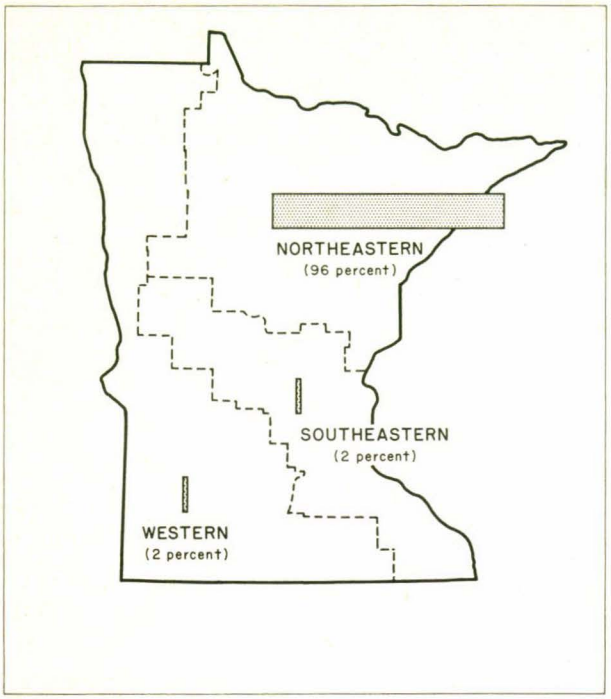

FIGURE 30.—*Where pulpwood was cut in 1953.*

Nearly all the wood was cut in the northeastern and north-central part of the State. Species most in demand were tamarack, jack pine, and cedar.

Current Rate of Cutting

The total cut of timber products in 1953 was 213,403,000 cubic feet or about 2,667,500 cords. This is lower than the cut in 1951 but slightly above that of 1950 and 1952.

Not All Cut Is From Growing Stock

Approximately 72 percent of the output came from growing stock—sound, live sawtimber and poletimber (fig. 35).

Cull trees and dead trees contributed substantial volumes to the 1953 cut. Fuelwood operations took the major share of this type of material, but some went into mine timbers, some into posts, and a little into other products. Saplings (i. e., trees less than 5 inches in diameter) yielded some merchantable products. Small spruce was used for pulpwood, cedar for fence posts, other species for fuel and miscellaneous products. Some of the cut was obtained from lands classed as noncommercial or nonforest.

Logging Residues Rather Large

About 10 percent of the cut of growing stock consisted of logging residues—material left in the woods or lost in transit. There is generally close utilization of the better grades of timber in Minnesota, but among the less-favored species and poorer grades, especially in localities distant from good markets, some volume of potential product is left in the woods (fig. 36).

Sawtimber Trees Furnish 39 Percent of Cut

Sawtimber trees containing 261,697,000 board-feet of logs plus 150,000 cords of top wood supplied 39 percent of the total volume taken for timber products in 1953. As would be expected, the proportion of sawtimber cut ran highest in lumber operations, lowest in pulpwood (fig. 37).

Softwood and Hardwood Cut Equal

The total cut of growing stock in 1953 was 51 percent softwood, 49 percent hardwood. The proportion of softwood ran a bit higher in the sawtimber cut—53 percent (table 24). Jack pine among the softwoods and aspen among the hardwoods contributed the largest volume.

TABLE 24.—*Timber cut from growing stock in Minnesota, by species, 1953*

Species	Total	Saw-log material	Cordwood material
	Thousand cu. ft.	*Thousand bd.-ft.*	*Cords*
Softwoods:			
White pine	4,363	19,385	13,000
Red pine	5,475	23,817	18,000
Jack pine	25,326	54,466	189,000
Spruce	23,617	14,650	259,000
Balsam fir	13,375	15,207	129,000
Tamarack	3,074	4,043	28,000
Cedar	2,736	6,523	19,000
Total	77,966	138,091	655,000
Hardwoods:			
Sugar maple	1,169	1,927	10,000
Soft maples	537	1,660	3,000
Yellow birch	544	1,342	4,000
Basswood	3,058	13,269	12,000
Elm	3,955	11,823	23,000
Red oak	10,453	22,404	52,000
White oak	3,484	7,448	49,000
Aspen	43,949	43,981	428,000
Cottonwood	1,686	6,025	8,000
White birch	3,517	8,027	25,000
Ash	2,020	3,633	15,000
Black walnut	180	360	2,000
Other [1]	1,634	1,707	13,000
Total	76,186	123,606	644,000
All species	154,152	261,697	1,299,000

[1] Boxelder, willow, hickory, hackberry, cherry, butternut, locust.

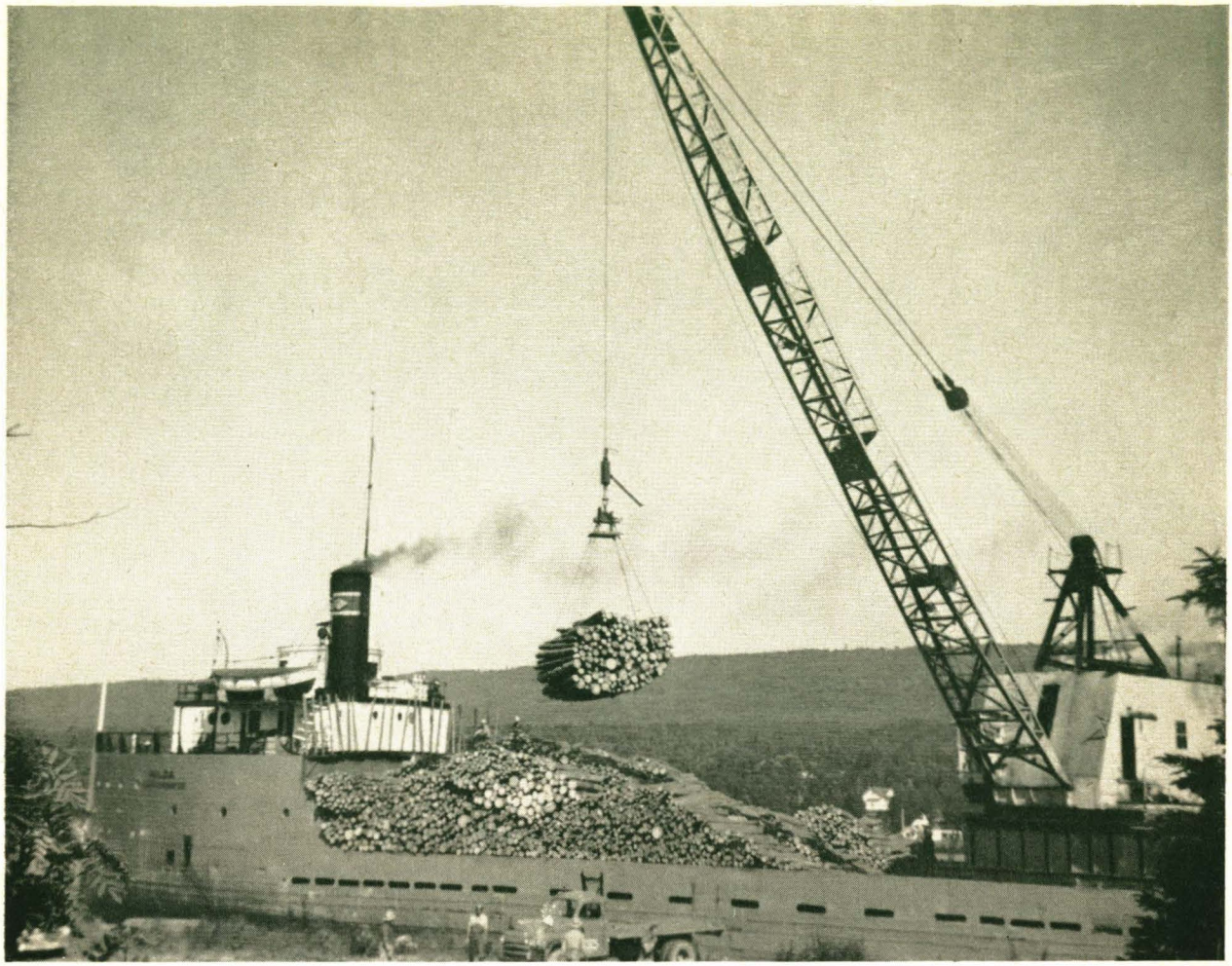

FIGURE 31.—*Spruce and balsam pulpwood being loaded on Great Lakes freighter at Grand Marais, Minn. Fully loaded, the ship carries between 1,500 and 1,800 cords. The cargo is transported across Lake Superior to Munising, Mich., where it is unloaded and shipped by rail to Michigan and Wisconsin pulp and paper companies.*

Private Lands Supply Three-fifths of Timber

Privately owned forest lands that have but 44 percent of the forest area and standing timber nevertheless supplied 64 percent of the timber cut in 1953. They produced about two-thirds of the aspen, and all but 4 percent of the mixed hardwoods cut that year (fig. 38 and table 25).

Private lands yielded about 63 percent of the logs and bolts for sawmills and 53 percent of the pulpwood. They produced most of the fuelwood, fence posts, and veneer logs. On the other hand, they furnished only a small proportion of the utility poles, piling, and mine timbers (fig. 39).

Federal lands contributed about 16 percent of the 1953 cut, State lands 12 percent, and county lands 8 percent. The Chippewa and Superior National

TABLE 25.—*Timber cut from growing stock, by ownerships, Minnesota, 1953*

Species	All ownerships	Federal	State	County	Private
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Softwoods:					
White and red pine	9,838	3,545	1,325	135	4,833
Jack pine	25,326	7,100	3,000	2,100	13,126
Spruce	23,617	4,475	6,030	1,330	11,782
Balsam fir	13,375	1,300	2,400	4,315	5,360
Other softwoods	5,810	560	1,720	785	2,745
Total	77,966	16,980	14,475	8,665	37,846
Hardwoods:					
Aspen	43,949	6,450	4,475	2,955	30,069
Other hardwoods	32,237	580	380	315	30,962
Total	76,186	7,030	4,855	3,270	61,031
All species	154,152	24,010	19,330	11,935	98,877

FIGURE 32.—*The Diamond Match Co. plant at Cloquet is a heavy user of quality aspen and birch timber for manufacture of square match splints and outer match boxes. (Photo courtesy Diamond Match Co.)*

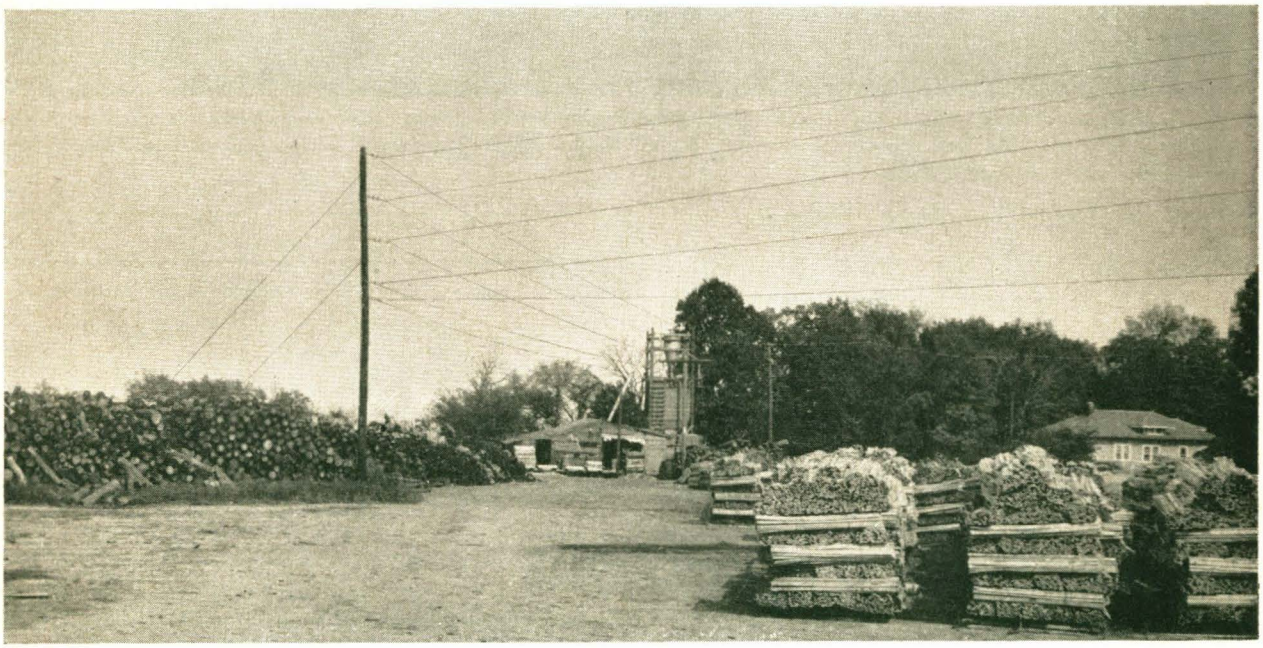

FIGURE 33.—*The Wheeler Lumber Bridge & Supply Co. This mill manufactures lath almost entirely from aspen bolts. It is probably the largest mill of its kind in the State. Most of the lath produced in Minnesota is used for snow fences. (Photo courtesy Wheeler Lumber Bridge & Supply Co.)*

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FIGURE 34.—*Kind of timber cut for fuel in 1953. Fuelwood in foreground is made up almost entirely of material cut from cull trees, tops, limbwood, etc. Only about one-third of the fuelwood produced in Minnesota each year is cut from merchantable timber. The steady decline in use of fuelwood through most sections of the State results in more low-grade material being left in woods.*

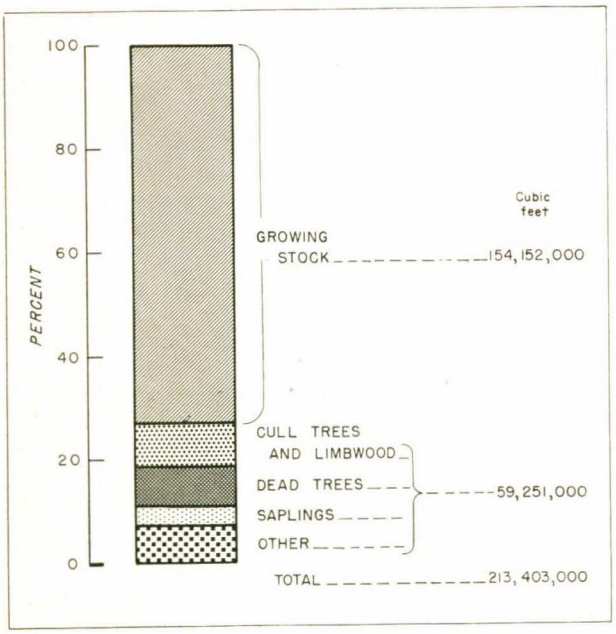


FIGURE 35.—*Kinds of timber cut in Minnesota, 1953.*

Forests yielded nearly 200,000 cords of cordwood material and 33 million board-feet of saw logs, about 75 percent of all timber cut from Federal lands. The yield from Indian lands amounted to 23 percent, Fish and Wildlife Service lands 2 percent.

Cutting on national-forest lands has increased substantially as management plans have been completed and as a system of access roads has been initiated to open up remote timber stands. On State and county forest lands cutting also has increased, especially in small operations where recent inventories have shown a surplus of timber over growing stock needs. In spite of these increases on public lands, the heaviest impact of cutting still falls upon the privately owned lands.

Accessible Areas Cut Most Heavily

About 79 percent of all timber (growing stock) cut and 73 percent of the sawtimber cut in 1953 came from the northeastern division (fig. 40 and table 26). Considering pulpwood species alone, an even larger share was cut in the northeast.

F-428512

FIGURE 36.—*Poor utilization of top material on cutting operation north of Virginia, Minn. A total of 14,151,000 cubic feet (175,000 cords) of material was left or destroyed in the woods through cutting operations in 1953. About 155,000 cords were rough material in the upper part of the tree stem, and 9,500,000 board-feet were in logs and bolts broken in felling or lost en route from stump to mill.*

TABLE 26.—*Cut of sawtimber and growing stock, by geographic division, Minnesota, 1953*

Class of material and species group	Total	Division		
		North-eastern	South-eastern	Western
Growing stock:	*Milliom cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*
Softwoods	78.0	74.2	2.0	1.8
Aspen	44.2	39.1	2.1	3.0
Other hardwoods	32.0	8.8	16.8	6.4
Total	154.2	122.1	20.9	11.2
Sawtimber:	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*
Softwoods	138.1	132.6	2.9	2.6
Aspen	44.1	38.0	2.2	3.9
Other hardwoods	79.5	21.4	45.6	12.5
Total	261.7	192.0	50.7	19.0

Within the northeastern division, some significant differences appear. The 1953 cut of softwood pulp species in the district accessible to Brainerd, Bemidji, and Grand Rapids was equivalent to 4.3 percent of the softwood pulpwood timber inventory. The cut in Lake of the Woods and Koochiching Counties was 3.4 percent. In the Counties of St. Louis, Lake, and Cook, the cut was but 2.5 percent of inventory, reflecting poorer accessibility and more difficult logging conditions.

Trends in Timber Cut

Lumber Decline Halted

Lumber manufacture in Minnesota declined precipitately from 1899 to 1934 (fig. 41). It rose considerably during World War II and the postwar years, reaching a peak of 244 million board-feet in 1947. During the period 1946–54 production aver-

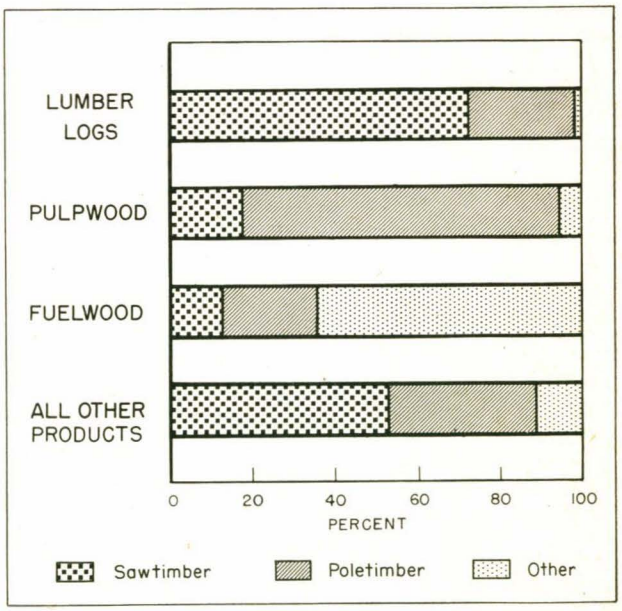


FIGURE 37.—*Proportion of sawtimber and poletimber cut for forest products, 1953.*

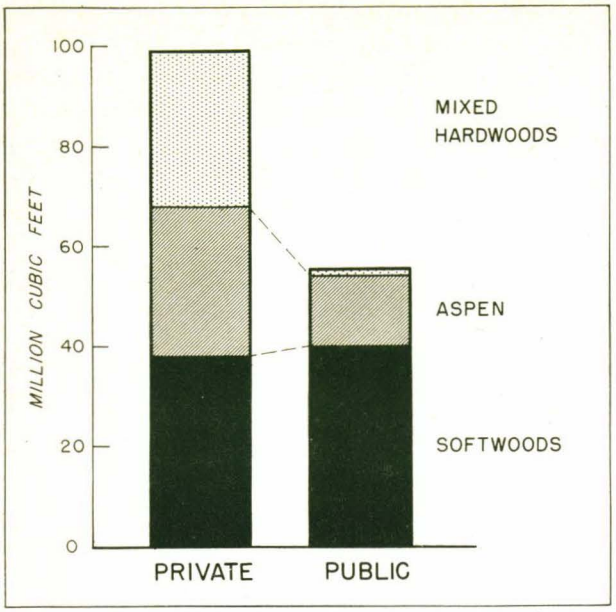


FIGURE 38.—*Timber cut from private and public lands, by species groups, 1953.*

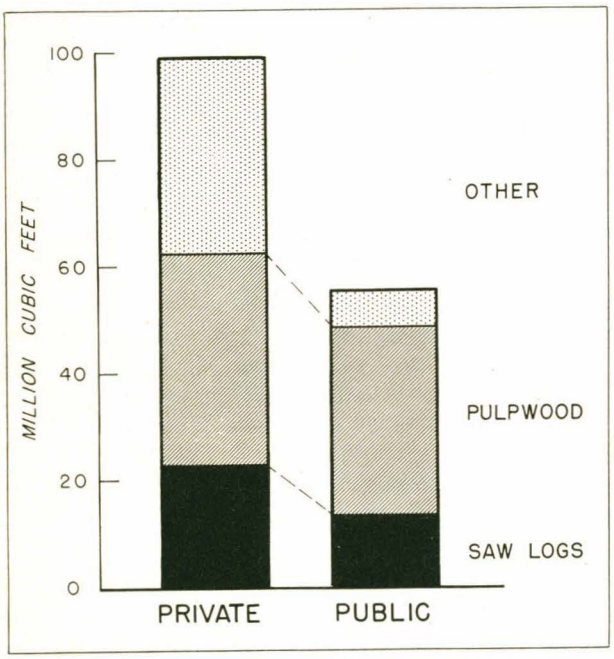


FIGURE 39.—*Timber cut from private and public lands, by forest products, 1953.*

aged 202 million board-feet, includlng 104 million board-feet of softwoods and 98 million board-feet of hardwoods.

Pulpwood Operations Expanding

From about 28,000 cords in 1904, pulpwood cutting increased to nearly 1 million cords in recent

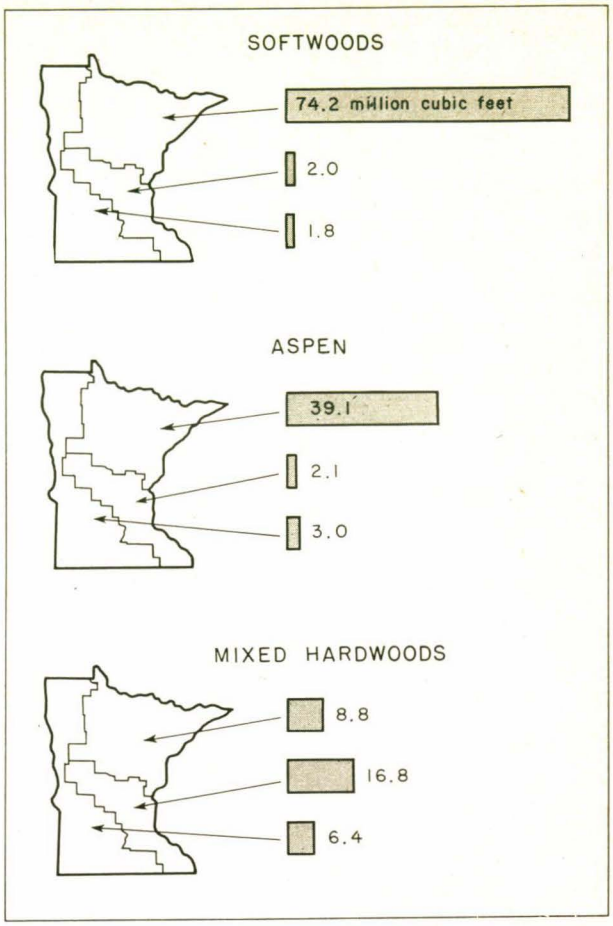


FIGURE 40.—*Timber cut from the northeastern, southeastern, and western divisions, by species groups, 1953.*

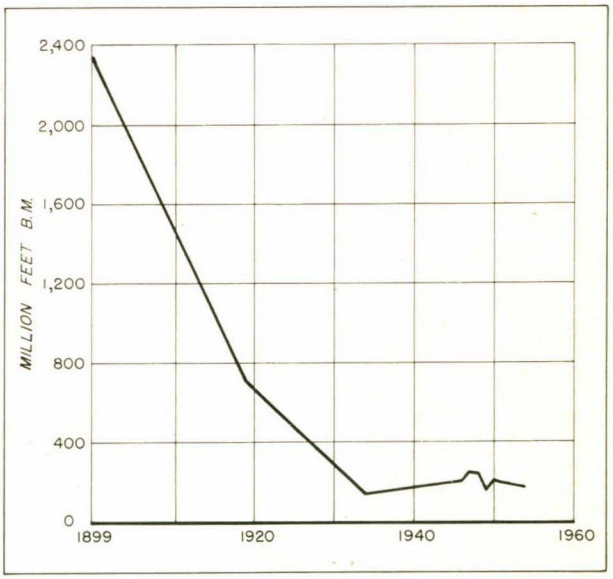


FIGURE 41.—*Minnesota lumber production, 1899–1954.*

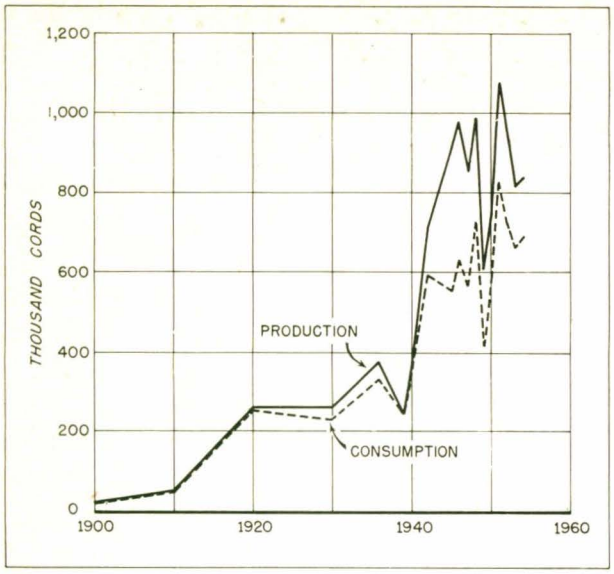


FIGURE 42.—*Trend in Minnesota pulpwood production and consumption, 1900–1954.*

years (fig. 42). In the period 1946–54 production of softwood pulpwood averaged about 620,000 cords and hardwood pulpwood about 250,000 cords.

Less Wood Cut for Fuel

Accurate records are not available to show year-to-year trends in fuelwood cutting. Available evidence indicates a substantial decline in quantities cut, both on farms and on commercial operations.

Production in 1936 was estimated at 2,200,000 cords, with about 36 million cubic feet coming from growing stock (by present inventory standards). In 1953, it was 1,197,000 cords with 29,760,000 cubic feet from growing stock. Although the 1953 cut was only about half the 1936 cut, it apparently included a smaller proportion of logging residues and other salvage, and thus was only 17 percent less in terms of growing stock removal.

Veneer Log Production Gaining

The cut of veneer logs approximately trebled between 1946 and 1952 and increased further in 1954 (table 27). Three-fourths of the logs were shipped to other States in 1952.

Some Industries Dropping Out

Cooperage mills, which as recently as 1947 took 3 million board-feet of local hardwood logs, have practically ceased to use Minnesota timber (table 27).

No excelsior mills operate now in Minnesota. About 700 cords of excelsior bolts were cut for shipment to Wisconsin in 1952. The cut in 1946 was 3,000 cords, mostly going to a Minnesota mill (table 27).

Lath and shingle production is very small compared with the output 50 years ago but is holding fairly steady at current levels.

TABLE 27.—*Veneer log, cooperage log and excelsior bolt production, Minnesota, 1936, 1946–52, and 1954*

Year	Veneer logs [1]			Cooperage logs—all hardwoods [1]	Excelsior bolts—all hardwoods
	Total	Softwoods	Hardwoods		
	Thousand bd.-ft.	*Thousand bd.-ft.*	*Thousand bd.-ft.*	*Thousand bd.-ft.*	*Thousand cords*
1936	[2] 6,500	[2] 200	[2] 6,300	280	2.4
1946	2,500	30	2,470	2,600	3.0
1947	4,805	20	4,785	3,000	2.0
1948	7,105	5	7,100	2,100	----
1949	6,670	20	6,650	1,660	.2
1950	6,370	30	6,340	1,260	.3
1951	7,250	20	7,230	650	.5
1952	8,000	8	10,375	18	.7
1954	10,390	15	10,375	11	----

[1] International ¼-inch rule.
[2] Includes match stock not shown for other years.

Pole and Post Business Rebounding

Production of cedar poles, at one time a fairly large business in Minnesota, has declined to a very low level. On the other hand, there has been a substantial increase in production of pine poles in recent years (table 28).

Use of wooden posts slumped during and after World War II. Manpower shortages and the inroads of steel were the primary causes. Recently, wooden posts have recovered some of the lost ground—partly as a result of improved quality of production and treatment; 1952 output was half again as large as that of the low year 1949 (table 28).

Mine Timber Use Falling Off

Year-to-year demands for mine timber, such as posts, ties, and lagging, fluctuate in fairly close harmony with ore production. The long-range trend, however, appears to be gradually downward. The development of open-pit mining is an important factor in this downward trend. Production of mine timbers in 1952 was less than half that in 1936 (table 28).

Total Cut Increasing

Timber cutting in Minnesota reached a low point during the early 1930's when operations were affected both by economic depression and depleted timber supplies. Since 1934 the trend in cutting has been gradually upward (fig. 43).

TABLE 28.—*Pole, post, and mine timber production, Minnesota, 1936, 1946–52, and 1954*

Year	Poles			Posts			Mine timbers		
	All species	Pine	Cedar	All species	Soft-woods	Hard-woods	All species	Soft-woods	Hard-woods
	Thou-sand pieces	*Thou-sand pieces*	*Thou-sand pieces*	*Thou-sand pieces*	*Thou-sand pieces*	*Thou-sand pieces*	*Thou-sand cu. ft.*	*Thou-sand cu. ft.*	*Thou-sand cu. ft.*
1936	113	0	113	10,000	2,500	7,500	4,000	3,500	500
1946	145	32	113	6,000	1,900	4,100	1,710	1,625	85
1947	220	68	152	6,000	1,900	4,100	2,290	2,180	110
1948	140	25	115	6,000	1,900	4,100	2,770	2,630	140
1949	90	18	72	5,000	1,800	3,200	2,220	2,115	105
1950	70	15	55	7,000	3,000	4,000	2,625	2,495	130
1951	90	26	64	7,500	2,800	4,700	2,650	2,525	125
1952	136	30	106	7,769	2,615	5,154	1,893	1,725	168
1954	130	90	40	7,700	2,700	5,000	1,608	1,465	143

The increase in cut from 1936 to 1952 has been more apparent in hardwoods than in softwoods, and in growing stock than in sawtimber (table 29).

The increase in sawed material (lumber) has been less than in pulpwood (table 30).

TABLE 29.—*Volume of timber cut from growing stock, Minnesota, 1936 and 1946 to 1953*

Year	All growing stock			Sawtimber material		
	All species	Soft-woods	Hard-woods	All species	Soft-woods	Hard-woods
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand bd.-ft.*	*Thousand bd.-ft.*	*Thousand bd.-ft.*
1936	110,250	60,300	49,950	223,100	144,550	78,550
1946	177,521	84,890	92,631	231,150	99,780	131,370
1947	179,763	84,235	95,528	260,750	112,805	147,945
1948	189,107	89,185	99,922	261,115	110,540	150,575
1949	132,970	62,035	70,935	194,120	84,300	109,820
1950	142,508	72,420	70,088	231,530	118,610	112,920
1951	165,963	91,498	74,465	276,174	161,033	115,141
1953 [1]	154,152	77,966	76,186	261,697	138,091	123,606

[1] 1952–53 logging season.

TABLE 30.—*Volume of growing stock cut for various products, Minnesota, 1936 and 1946–53*

Year	Total	Lumber	Pulp	Veneer	Fuel	Poles and posts	Other products
	Million cu. ft.	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*
1936	110.2	27.9	30.0	1.5	36.0	7.7	7.1
1946	177.5	49.6	75.2	.5	35.8	7.0	9.4
1947	179.8	59.1	65.8	1.0	35.8	7.9	10.2
1948	189.1	57.9	76.8	1.5	35.8	6.9	10.2
1949	133.0	33.8	48.6	1.1	35.8	5.6	8.1
1950	142.5	44.3	60.4	1.1	23.0	6.1	7.6
1951	166.0	37.4	86.2	1.2	28.9	6.0	6.3
1953 [1]	154.2	36.4	74.6	1.4	29.8	6.4	5.6

[1] 1952–53 logging season.

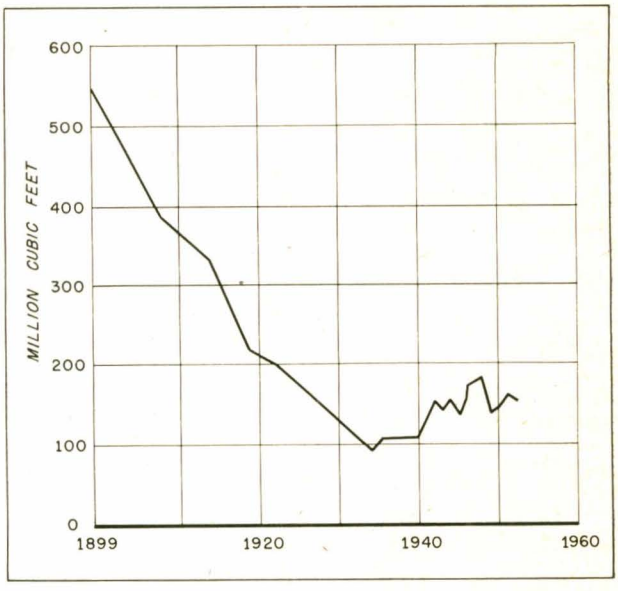


FIGURE 43.—*Trend in total timber cut, 1899–1953.*

Problems Highlighted by Survey

Available Supplies Not Fully Utilized

THE QUANTITY of wood harvested in 1953 amounted to only about half the material theoretically available for cutting (fig. 44, table 31). The theoretical allowable cut, of course, includes all operable stands ready for harvesting regardless of location, species composition, or log grade. The cut in 1953 also amounted to only one-third of the net annual growth of sawtimber and 40 percent of the growth of growing stock.

TABLE 31.—*Net annual growth, annual mortality, annual cut, and allowable cut of live sawtimber and growing stock on commercial forest land, by species groups, Minnesota, 1953*

Item	Sawtimber			Growing stock		
	Total	Soft-wood	Hard-wood	Total	Soft-wood	Hard-wood
	Million bd.-ft.	*Million bd.-ft.*	*Million bd.-ft.*	*Million cu. ft.*	*Million cu. ft.*	*Million cu. ft.*
Net annual growth	788	329	459	385	118	267
Annual mortality	194	88	106	173	68	105
Annual cut:						
Timber products	252	133	119	140	72	68
Logging residues [1]	10	5	5	14	6	8
Total	262	138	124	154	78	76
Allowable cut	524	223	301	247	95	152

[1] Small volume cut in land clearing not included.

Some Hardwoods Overabundant

Outstanding examples of incomplete utilization are in aspen, paper birch, ash, and elm (table 32). In some localities in the north, even maple and basswood show an excess supply. Generally, however, the good grades of hardwood sawtimber—especially of yellow birch, basswood, oak, cottonwood, and walnut—are used more fully than is desirable. In these species the need for additional cutting is either in remote localities or in trees with a large proportion of low-grade logs.

All of the principal pulp species show some margin of surplus over actual 1953 cut for the State (table 33). Significantly, the surplus pine and spruce is confined to the relatively inaccessible Superior District.

TABLE 32.—*Comparison of allowable annual cut and actual 1953 cut, by species, Minnesota*

Species	Allowable cut	Actual cut, 1953
	Million cu. ft.	*Million cu. ft.*
Softwoods:		
White pine	6.0	4.4
Red pine	5.3	5.5
Jack pine	29.7	25.3
Spruce	25.1	23.6
Balsam fir	18.0	13.4
Tamarack	5.1	3.1
Cedar	6.3	2.7
Total	95.5	78.0
Hardwoods:		
Sugar maple	2.6	1.2
Soft maples	1.2	.5
Yellow birch	.4	.5
Basswood	6.2	3.1
Elm	8.2	4.0
Oak	14.1	13.9
Aspen	90.4	43.9
Cottonwood	1.2	1.7
Paper birch	16.4	3.5
Ash	5.3	2.0
Black walnut	.1	.2
Other hardwoods	5.4	1.7
Total	151.5	76.2
All species	247.0	154.2

TABLE 33.—*Comparison of allowable cut and actual 1953 cut for principal pulp species, Minnesota*

Species	State		Superior district [1]		All other districts	
	Allowable cut	Actual cut, 1953	Allowable cut	Actual cut, 1953	Allowable cut	Actual cut, 1953
	Thousand cords	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*
Softwoods:						
Jack pine	371	317	231	123	140	194
Spruce	314	295	182	112	132	183
Balsam fir	225	167	105	46	120	121
Total	910	779	518	281	392	498
Aspen	1,130	549	355	143	775	406
All pulp species	2,040	1,328	873	424	1,167	904

[1] Consists of Cook, Lake, and St. Louis Counties.

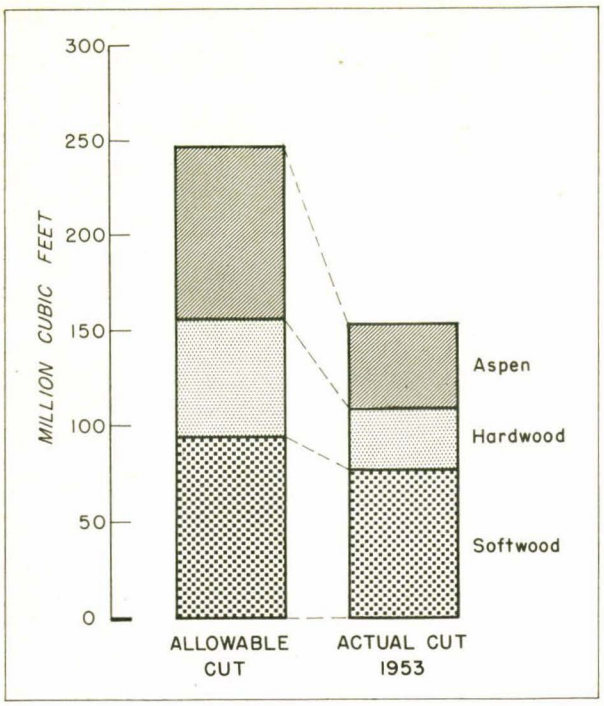


FIGURE 44.—*Comparison of allowable cut and actual cut of all growing stock, 1953.*

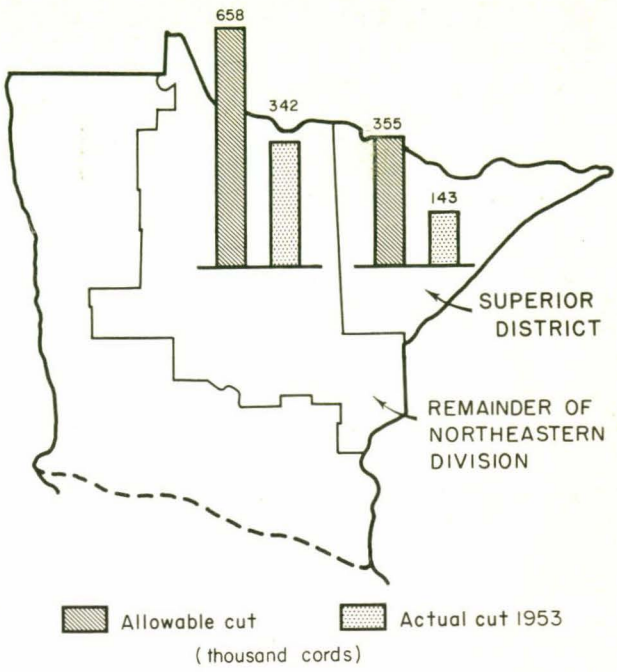


FIGURE 45.—*Allowable cut exceeds actual cut of aspen most noticeably in the Superior District.*

Aspen Offers Large Surpluses

Estimates indicate that 1,130,000 cords of aspen (90.4 million cubic feet) could be cut annually—581,000 cords (46.5 million cubic feet) more than was actually cut in 1953.

Surplus aspen is available throughout northeastern Minnesota but is especially abundant in the Superior District—Cook, Lake, and St. Louis Counties (fig. 45) where it occurs over extensive areas and includes many trees of saw-log size. However, the timber is of only fair quality and is far from markets. Under present conditions much of it is not profitable to log.

Elsewhere in the State the surplus aspen consists, to a considerable extent, of light concentrations of small and often low-grade timber. In southern and western counties, the surplus wood is found in scattered patches at considerable distances from existing pulpwood markets.

With a better knowledge of aspen distribution provided by the recently completed surveys and with progress being made in utilization and marketing research, more aspen will probably be used in the period ahead, but it seems unlikely that the full potential cut can be realized soon.

Pine Overcut in Accessible Areas

State wide, the actual cubic-foot cut of white and red pine in 1953 was 12 percent below the allowable cut. This favorable balance occurred because the available supply in the inaccessible parts of the Superior District could not be harvested. Elsewhere the cut exceeded the desirable level by about 10 percent. More serious than the volume difference was the fact that some of the actual cutting amounted to stand liquidation rather than to the kinds of cutting recommended for these types. Such destructive cutting, however, was on a smaller scale in 1953 than during World War II.

In jack pine also, the actual cut on lands close to mills and transport routes exceeded the desirable level. In northeastern Minnesota outside the Superior District, the actual cut in 1953 was 182,000 cords whereas the recommended figure is 127,000, indicating a 43 percent overcut (fig. 46). Destructive cutting was less common than during the war.

The problem of getting more complete utilization of available pine, especially in the Superior District, falls primarily on public agencies. That of adjusting cut to capacity of young stands and of improving cutting practices in areas close to mills will require action by private owners.

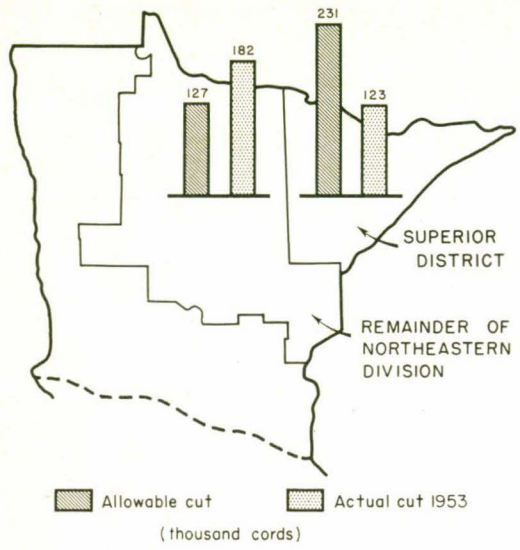


FIGURE 46.—*Jack pine surpluses were confined to Superior District.*

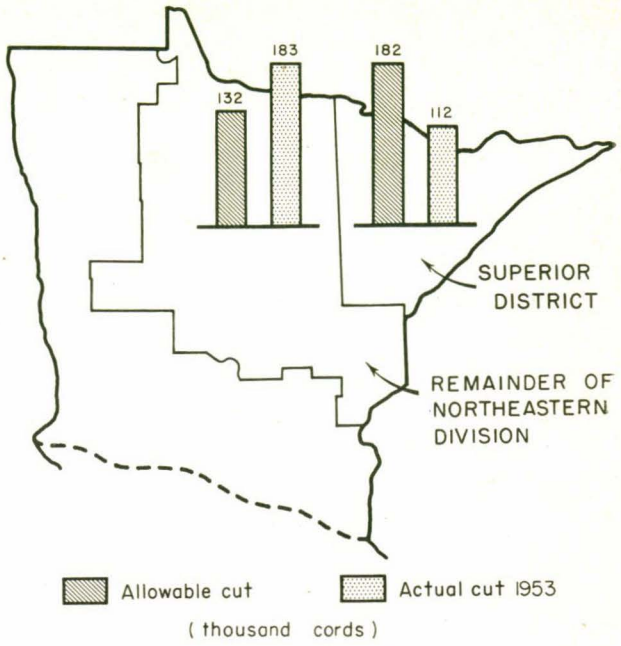


FIGURE 47.—*Spruce is overcut except in Superior District.*

Spruce Unevenly Used By Locality

For spruce, the actual cut in 1953 was 6 percent less than the estimated allowable cut. However, in in the districts outside the Superior, the actual cut was 183,000 cords compared with a recommended 132,000 cords. This 39 percent overdraft is serious. On the Superior District a 62 percent increase is possible (fig. 47).

Surplus Balsam Fir Available

Actual cut of balsam fir in 1953 was 167,000 cords compared with 225,000 available. The main surplus was in the Superior District. However, many of the public forests and some private lands elsewhere have isolated tracts of mixed timber where balsam fir is going to waste for lack of use. Like aspen, this species cannot be stored indefinitely. If not harvested when mature, balsam fir will deteriorate rapidly.

Tamarack and Cedar Accumulating

Under good management, the swamps and swamp margins in Minnesota could yield 65 percent more tamarack and 133 percent more cedar than was cut in 1953. Most of the surplus is small trees obtainable from thinnings and partial cuttings. This surplus would be suitable mainly for fence posts, small poles, mine poles, and lagging.

New Industries Needed

The forests unquestionably are able to support more forest industries; however, they will not support indiscriminate expansion.

Present sawmill capacity is more than adequate to take care of timber of saw-log size and quality. Some readjustment in mill location would be desirable. A few mills, sawing more efficiently and producing a better grade of lumber, no doubt could operate profitably. Further growth of the pulpwood industry is possible. Expansion of existing plants and addition of one or two new pulp or fiber mills would be desirable if they can be adapted to utilize the available aspen and other hardwoods, and some presently inaccessible softwoods.

Surplus tamarack is now available for posts, small poles, mine poles, and lagging. With the gradual increase in size, the species can be used in larger volume by the local sawmill and mining industry for mining and structural timbers and railroad ties. Tamarack is a potential pulpwood. As for cedar, present operations could be expanded, especially in the northeastern section of the State where the resource is now largely going to waste.

A more diversified industry, closer integration of plants, and closer wood utilization will help to bring the annual cut into balance with the growth capacity of the forests.

Too Much Land Is Understocked

Although the Minnesota forests have improved in some respects since 1936, they still lack many characteristics of a well-managed forest. The 4,483,000 acres of nonstocked land, for example, and 1,671,000 acres of poorly stocked seedlings and saplings sharply reduce the average yields of timber.

Softwood Types Losing Ground

Originally, Minnesota had about 18 million acres of softwood forest out of a total forest area of 31.5 million acres. By 1936, the softwood area had been reduced to 5,171,000 acres of commercial forest; by 1953, after heavy cutting during the war years, it was down to 4,445,000 acres. Land clearing has been responsible for more than half of the reduction in the original area. Forest fires and destructive logging have converted millions of acres to aspen, grass, and brush. Now with improved fire protection and better cutting practices, there is some natural reconversion, but it is progressing at a rather slow pace. Most authorities agree on the need for planting to accelerate restoration of softwood because both locally and nationally the demand is greater for softwoods than for hardwoods.

Uneven Distribution of Stand-Size Classes

For sustained production, a forest should have an even distribution of age-classes in each type from youngest seedlings up to mature harvestable timber. This condition is not found in many places in Minnesota; generally, there is a shortage of merchantable and near-merchantable timber and an excess of very young timber.

In the northeastern division only 7 percent of the area supports sawtimber. The other divisions have somewhat better balance but lack sufficient timber of advanced size.

A few forest types have shortages in the smaller size classes. The white and red pine types have two-thirds of their acreage in sawtimber, some of it overmature, and have but small acreages in poles, saplings, and seedlings. This situation may not be quite as bad as it appears since some other forest types include young pine, but not enough to classify as pine type.

Several of the hardwood types, notably ash-elm-cottonwood and maple-birch, can be managed best in most places as all-aged forests. For this, the type should be maintained as a sawtimber stand. At present, only a little more than one-third of these types is classified as sawtimber.

Too Much Low-Grade Timber

Because two-thirds of its hardwood sawtimber is classed as No. 3 or lowest quality grade, Minnesota is handicapped in promoting new wood-using industries.

To a considerable extent, the No. 3 classification applies because of the small size of the timber. If allowed to grow for 20 years, some of these logs will make No. 2 and a few No. 1 grades.

In some places the timber is short and limby because it is too open grown. In farm woods this may be a result of grazing. Elsewhere it may be a result of poor site, poor seed sources, burning, or some other cause. These conditions can be remedied but it will take time.

Some forest areas have accumulations of overmature, decadent, cull, and even dead timber that have been passed by loggers. These accumulations not only waste growing space but they serve as breeding places for insects and fungi, and thus are a menace to the forest. How to dispose of such material is one of the biggest forestry problems facing the State.

Mortality Excessive

Losses from various natural causes—fire, wind, diseases, insects, etc.—are greater in Minnesota than in most other States. The annual loss of 2.4 percent of growing stock is an exceedingly high rate.

One reason for high mortality is the prevalence of vulnerable species, of which aspen is the outstanding example. On poor sites—that is, on wet ground or very sandy ground—aspen commonly succumbs to disease before the stands reach good operable size. The long-run solution is to restore these areas to the types of timber for which they are better suited—spruce, pine, or bottom-land hardwood. On better sites and in areas tributary to good markets, aspen needs to be cultivated intensively with frequent light cuttings to forestall mortality. In more remote areas where frequent cutting is impractical, the more prudent course, regardless of site, may be to encourage replacement of aspen by longer lived and less vulnerable species.

Jack pine and balsam fir also are relatively short-lived species and deteriorate rapidly after maturity. Overmature stands in areas not accessible by road present a problem that the State is trying to solve by

building access roads. For some areas, the long-run solution may be species replacement—say red pine for jack pine, spruce for balsam fir. Meanwhile, timely logging, mostly on a partial cutting schedule, can forestall much of the mortality.

In the hardwood types, removal of cull and other poor trees to the extent practicable will help to reduce losses from natural causes.

To suggest that mortality could be entirely eliminated from the forests would be unrealistic, but under better forest management involving improvement and salvage cuts a substantial reduction of present losses could be expected.

Management Responsibilities Divided

Minnesota forest lands are owned by a large number of different individuals and agencies. Conditions on these lands vary, as do the objectives of the owners. Therefore, the problems of management are complicated.

Total forest area may be restated thus:

	Acres	*Percent*
Federal	3, 055, 000	17
State	3, 484, 000	19
County	3, 619, 000	20
Farmers	4, 881, 000	27
Other private	3, 059, 000	17
Total	18, 098, 000	100

Public Agencies Have Most Surplus Wood

Analysis of conditions on lands of different ownership shows that much of the timber surplus is on public lands primarily because these areas are less accessible. In many places, privately owned forests are being overcut.

Of softwood pulp species, public forests could supply 295,000 cords more than was cut in 1952 (fig. 48). Federal forests alone had a surplus of 217,000 cords (table 34), State forests 67,000 cords, and county lands 11,000 cords. On the other hand, private lands had an allowable cut deficit of 171,000 cords.

Of aspen, public forests could supply 457,000 cords more than were cut in 1953. Federal forests had a 191,000 cord surplus, State forests 95,000 cords, county forests 171,000 cords. For this species private lands also contained a small surplus of 42,000 cords (fig. 49).

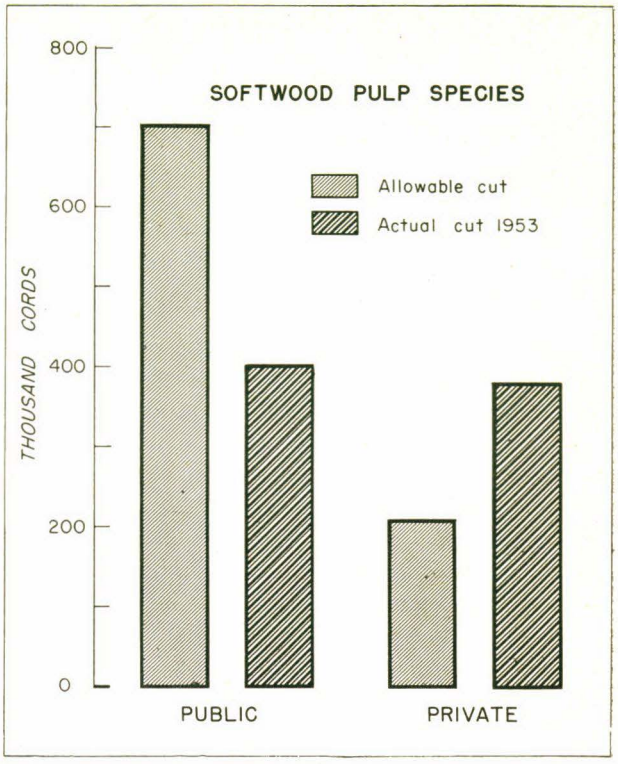


FIGURE 48.—*Surpluses of softwood pulp timber exist on public forests, while private lands are overcut.*

TABLE 34.—*Comparison, by ownership and species group, of Minnesota's allowable annual cut and actual 1953 cut for pulpwood and sawtimber*

SAWTIMBER

Ownership	All species		Softwoods		Hardwoods	
	Allowable cut	Actual cut	Allowable cut	Actual cut	Allowable cut	Actual cut
	Million bd.-ft.	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*	*Million bd.-ft.*
Federal	154	48	93	35	61	13
State	83	37	45	27	38	10
County and municipal	62	17	26	9	36	8
Private	225	160	59	67	166	93
All owners	524	262	223	138	301	124

PRINCIPAL PULPWOOD SPECIES

	Thousand cords	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*
Federal	649	241	378	161	271	80
State	363	201	212	145	151	56
County and municipal	316	134	108	97	208	37
Private	623	752	205	376	418	376
All owners	1,951	1,328	903	779	1,048	549

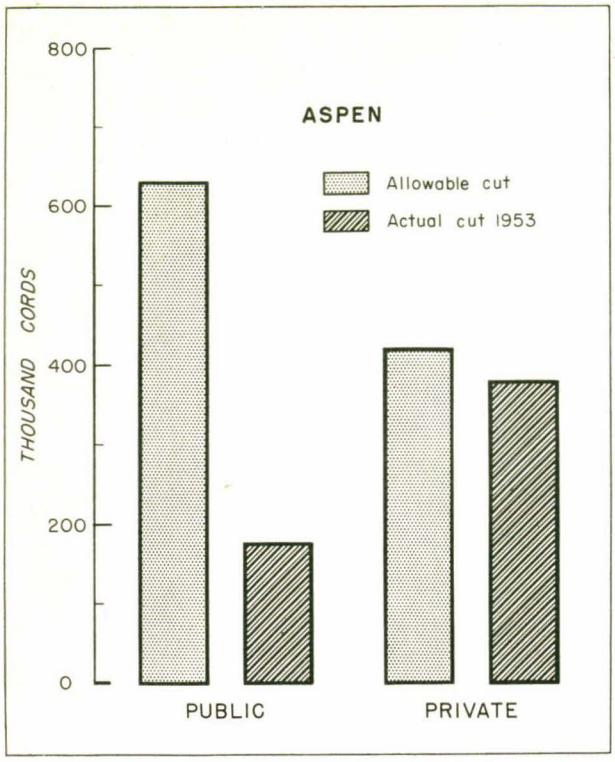


FIGURE 49.—*Public lands have large surpluses of aspen.*

National Forests Have Access Problems

The Superior National Forest in the northeast corner of the State occupies an area poorly provided with highways and navigable streams. The forest is at some distance from large wood-using centers. Lakes, swamps, and rock outcrops make parts of it difficult to log. As a consequence, the managers have been unable to market the full allowable cut. Main surpluses are in aspen, jack pine, spruce, and balsam fir, but include other species too. A solution has been sought in the development of access roads. This has helped but has not insured steady sales. In periods of slack demand for timber, operations here are the first to be curtailed. Attention is now being given to the possibilities for additional industries closer to the forest.

The Chippewa National Forest is better situated than the Superior with respect to markets, but it has similar problems on a smaller scale.

Other public agencies have much the same problems for at least parts of the areas they manage. The Bureau of Indian Affairs, the State Department of Conservation, and the counties of Cook, Lake, and St. Louis have lands intermingled with those of the Superior National Forest, on which the problem of marketing available stumpage is serious.

Difficult Management Problems on State and County Lands

Some State forests are well consolidated and lend themselves to independent management; others are scattered and interspersed with holdings of other agencies and private owners. Over a period of years, the Department of Conservation has made some progress in consolidating State holdings by exchanges, purchases, and acceptance of gifts, but many difficult problems of management remain.

Where limited State holdings are intermingled with actively operated holdings, usually in areas close to mills, heavy pressures develop to get the State timber on the market regardless of long-range management plans. On the other hand, where State holdings in more remote localities are intermingled with dormant holdings of other owners, the State has difficulty in finding buyers for its mature timber.

To overcome these difficulties, the State Division of Forestry has cooperated in some places with other owners in preparing integrated management plans satisfactory to all parties concerned. This development, still on a pilot-plant scale, seems to offer promise of solution for some of the ownership complications encountered in this State.

Fifteen years ago, most counties were merely custodians of forest land, large acreages of which had reverted to public ownership for nonpayment of taxes. Commissioners had very little conception of the potential values involved. Some were anxious to get the land back on the tax rolls and were ready to sell any or all land or timber to any interested purchaser. Others did not believe in selling anything at all.

As a result of the forest survey and related work by the Office of Iron Range Resources, the county commissioners came to realize that they had very valuable property capable both of returning considerable current revenue and of growing into something of infinitely greater value in the future. Most of the northern counties now have timber management plans for their holdings with a recognized cutting budget. Formerly, applicants were allowed to choose the timber they wanted to buy; now county officials have detailed maps and records showing what timber should be cut.

Most counties have a small staff of foresters who seek out buyers for available stumpage and who supervise

cutting to insure that good forestry practices are followed. In addition, a number of counties are engaged in planting programs. With this expanding activity it is to be expected that counties as a group soon will come much closer to their allowable cut figure than was indicated in 1953.

Management Varies on Private Lands

Forest industries own about one-half million acres of forest in Minnesota, a much smaller area than is held by other groups. However, because of the good location and selected quality of most of the tracts, these lands have considerable significance.

Pulp and paper companies are the principal industrial owners. Of these, 2 Minnesota companies have the dominant share, with 2 Wisconsin companies having most of the remainder. The pulp companies have been enlarging their holdings steadily over the past 10 years, and several have an expressed aim of owning enough timberland to supply at least one-third of their annual wood requirements.

Privately owned lands that are not controlled by forest industries and are not on farms aggregate more than 2,600,000 acres. Little is known about the actual ownership status. County tax lists include real estate companies, banks, mining companies, resorts, estates, and of course many individuals, both resident and out-of-State. The impression gained by survey personnel was that very few were doing anything active in the way of forest management.

That a large volume of timber is being harvested from these lands of mixed ownership is evident. In 1953, the actual cut on the private lands of this kind was considerably greater than the estimated allowable cut. There is little doubt that some tracts are being subjected to very destructive cutting.

Farm forestry has been making gains, but it is difficult to find measurable indices of change in farm woods. However, observations during the survey indicated, for example, that grass fires burning uncontrolled along the bluffs of the Mississippi River and tributary streams are now uncommon, whereas, at the time of the first forest survey in 1936 they were an annual occurrence. Grass fires are much less frequent also in the Red River Valley. This change accounts for much of the improved density of stocking noted in many of the survey plots.

There is evidence of considerable new planting of windbreaks and forest groves, especially in certain soil conservation districts where leaders have an active interest in trees, and where the Agricultural Conservation Program offers to share costs on farms for tree planting and care. Many farmers are requiring selective cutting, and some are doing the logging themselves. Extension foresters and Service foresters employed by the Conservation Department are providing assistance to farmers and other landowners.

Overall, however, the records indicate that too much high-quality growing stock of the high-value species is being cut on farm woods and not enough of the overmature, decadent, and cull material. Use of wood for fuel is definitely on the wane in Minnesota, and no substitute outlet has been found for low-grade material.

Conclusion

WITH A POTENTIALLY VERY PRODUCTIVE FOREST acreage, with more than half of this land in fairly stable public or industrial ownership, with nature working to heal the wounds of past mistakes, there is little reason for pessimism about forest conditions in Minnesota.

Some Gain Expected With Present Trends

According to allowable-cut estimates, the actual rate of cutting, if properly done, could be increased 50 percent over that of 1953, or to about 247 million cubic feet without damage to the forest growing stock. The increased cut should be primarily from areas where mortality from disease or other causes is high, or where many of the trees are mature or decadent, so that younger trees may be released or established. Although this increased cut would be mainly in aspen and other hardwoods, it could include softwoods in inaccessible locations.

Management plans, being adopted by public agencies and some industrial forest owners, forecast gradually improving yields over the next few decades. These should at least offset possible declines in unmanaged areas. Cuts within the 300-million to 400-million cubic-foot range are believed possible by 1975.

Management Can Improve Quality as Well as Quantity of Yields

To realize the potential values in Minnesota's orests, the owners of the land will need to do more onstructive planning for forest production. Through forest research, improved ways must be found to reduce losses, increase growth, and improve timber quality. On all ownerships there is need for consistent programs of good forest management.

On public lands, probably the most urgent needs are to develop access roads and to conduct active sales campaigns designed to accelerate cutting of overmature and decadent timber, thus making way for younger and thriftier stands.

In farm woods, the prime needs are to utilize or eliminate many cull and weed trees and to control livestock damage.

In unmanaged forests the immediate need is to adopt cutting practices that will build up and maintain a good growing stock. Measures to restore deforested areas, increase stocking, and improve the composition of the stands are also in order.

Minnesota Can Produce More Softwoods

The prospective yields without planting include large proportions of aspen and other hardwoods. On the other hand, the demand is strongest for softwoods both locally and nationally. It would be to the advantage of Minnesota to produce more softwood timber.

At least 8 million acres of forest land in this State are capable of growing softwoods, but only 4.5 million acres are now stocked with softwood types. Some lands restock naturally each year, but to restore conifers to all suitable lands within a reasonable period will require considerable planting.

Appendix

Forest Survey Methods

Areas

FOUR methods were used in the forest survey in Minnesota to collect the statistics on forest land areas.

1. ONE HUNDRED PERCENT MAPPING.—National forests and a few smaller areas were mapped completely.

2. RANDOM-BLOCK SAMPLING.—In nearly all the northeastern division outside of national forests, the area estimates were based on mapping of sample blocks, either four 160-acre blocks or nine 40-acre blocks selected at random in each township. The type, size, and stocking classes were delineated and classified on aerial photos before being checked on the ground.

3. DOT-BLOCK SAMPLING.—In the southeastern division and the northeastern parts of the western division, the dot-block method was used. The total forest area proportions were determined by counting and classifying as "forest," "nonforest," and "water," mechanically spaced dots on alternate aerial photographs. At every sixth forested dot, the legal 40-acre description in which the dot fell was used as a sample to break down the total forest land to type, size, and stocking classes. On the aerial photographs of each of these 40's, the type, size, and stocking classes were delineated and classified, and the forested dot was located. Every third 40 was ground checked to verify or change the classifications of the forested dot and the type, size, and stocking classes. These ground checks were then used to adjust the data on the samples that were not ground checked.

4. DOT SAMPLING.—In the thinly forested parts of the western division, the number of forest and nonforest dots counted and classified was increased. A 1-acre circle at every fourth forest dot was classified as to type, size, and stocking class, and varying percentages were ground checked to reach a specified level of accuracy.

Ownership

Information on forest area and timber ownership was obtained by examination of ownership records for the sample blocks at the various county offices.

Volumes and Growth

Volume and growth measurements were taken in ⅕-acre circular plots located on a random pattern within mapped areas. The resulting volumes and growth per acre were used with the area data to estimate total volumes and growth by species and classes.

Allowable Cut

The allowable cut represents the timber volume available for harvest under good forest management practices. It does not equal the volume that would be available under very intensive forest management, but does presuppose a management level higher than now exists statewide. It assumes forest protection and management aimed toward a sustained yield on all forest lands. It implies good forest practices such as salvage cuttings, intermediate cuttings, and planned controlled harvests.

Where much of the forest land is not well managed and consequently is either overcut or undercut, the allowable cut varies considerably from the amount actually removed. Nevertheless, allowable cut is a valuable guide for planning and evaluating progress in improving the management of the timber resource.

The appraisal of allowable cut was made as systematic as possible in order to reduce bias and insure uniformity. Field and office procedures, including standard rotation periods for the various types, were worked out in conferences with the Minnesota Forest Survey Committee, an advisory group composed of public and private Minnesota foresters.

A formula method recognizing areas in various stand-size classes, total volumes, growth, condition of the present stand, and rotation age was used in computing allowable cut for even-aged types such as aspen and jack pine. The basic formula was as follows:

$$HC = \frac{V + \frac{Gn}{2}}{n}$$

Where:

HC = annual harvest cut
V = volume of timber in the mature size class
G = annual growth of the mature size class
n = liquidation period of the mature size class

In application this formula was modified depending upon the length of the liquidation period and the number of size classes involved for the particular forest type. A detailed explanation of the formula method is included in the Lake States Forest Survey Handbook.

In addition to the harvest cut, intermediate cuts from immature stands are included to arrive at the total allowable cut for the even-aged types.

For types usually handled under an uneven-aged system of management, the cutting recommendations of field crews, including silvicultural as well as operability factors, were used to compute allowable cut. In order to recognize operability limitations, in the northeastern division a stand was not judged operable unless the timber available for cutting exceeded 1,500 board-feet per acre for sawtimber, or 3 cords per acre for pulpwood cuts. In the southern districts where stands are more accessible, the minimum cuts considered operable were 500 board-feet per acre for sawtimber and 1 cord per acre for cordwood material.

For both even and uneven-aged forest types, the basic concept was that the cut should be as high as possible while building up or maintaining sufficient growing stock to meet specified growth goals. Periodically, during the progress of the survey the estimates of allowable cut, as well as other forest survey statistics, were reviewed by the Minnesota Forest Survey Committee in order to maintain agreement on methodology and concepts.

Timber Cut

All sawmills, pulp and veneer mills, and other wood-using industries were canvassed by mail or interview to get an estimate of the amount of wood produced as primary forest products. Other surveys were made to estimate the amount of fuelwood and fence-post production. Studies were also made of timber residues to adjust the production by commodities to timber cut from inventory volumes. In addition, all public agencies were canvassed for the amount of wood sold during the cutting year, and this information was used to break down the total cut by ownership.

Accuracy of Survey

Areas

There were two sources of error in estimating the forest land area: (1) Errors in classifying the type, size, and stocking classes and in compiling the data, and (2) sampling errors. Frequent checks were made during the collection and compilation of the data, both in the field and in the office, to minimize the operational errors. The sampling intensity was sufficient to provide an estimate of the forest area of the State with a standard error of about 0.5 percent.

Volumes

The sources of error in estimating timber volume include: (1) Errors in measurement of plot radius, tree diameter, height, and cull; (2) improper construction or use of tree volume tables; (3) errors in collecting or compiling the plot data; and (4) sampling errors. As in the area determinations, every effort was made to obtain accurate measurements and final statistics through frequent checks and training. The number of plots taken in the State was adequate to provide a sampling error for total cubic-foot volume of not more than 1 percent, and a sampling error for total sawtimber volume of less than 1.5 percent. In all tables shown, the totals are more accurate than the subtotals, and the subtotals are more accurate than the individual items in the tables. Any item that is small in relation to the totals—for example, any volume estimate less than 10 million cubic feet—is subject to large sampling errors.

Definition of Terms

Land-Use Classes

FOREST LAND AREA.—Includes (1) lands that are at least 10 percent stocked by trees of any size and capable either of producing timber or other wood

products, or of exerting influence on the climate or on the water regime; (2) land from which the trees described in (1) have been removed to less than 10 percent stocking and which has not been developed for other use; and (3) afforested areas. (Forest tracts of less than 1 acre, isolated strips of timber less than 120 feet wide, and abandoned fields and pastures not yet 10 percent stocked are excluded.)

COMMERCIAL FOREST LAND AREA.—Forest land that is (1) producing, or physically capable of producing, usable crops of wood (usually sawtimber); (2) economically available now or prospectively; and (3) not withdrawn from timber utilization.

NONCOMMERCIAL FOREST LAND AREA.—Forest land (1) withdrawn from timber utilization through statute, ordinance, or administrative order but otherwise qualifying as commercial forest land; or (2) incapable of yielding usable wood products (usually sawtimber or pulpwood) because of adverse site conditions.

NONFOREST.—Land less than 10 percent stocked with trees and currently showing signs of use for purposes other than the growing of trees.

Forest Types

A forest type is a forest stand characterized by the predominance of one or more key species. Strictly speaking, predominance means that in sawtimber stands 50 percent or more of the saw-log volume is that of the key species; in poletimber stands 50 percent or more of cordwood volume; and on restocking areas 50 percent or more of small trees. However, each type contains some transitional areas in which no species makes up 50 percent. In these places the classification is based upon the species with the majority volume or number.

WHITE PINE TYPE (W).—Forest stand in which 50 percent or more of the volume or number of small trees is eastern white pine (common associates include red pine, jack pine, and aspen).

RED PINE TYPE (N).—Forest stand in which 50 percent or more of the volume or number of small trees is red pine (common associates include eastern white pine, jack pine, and aspen).

JACK PINE TYPE (J).—Forest stand in which 50 percent or more of the volume or number of small trees is jack pine (common associates include eastern white pine, red pine, and aspen).

BLACK SPRUCE TYPE (S).—Swamp conifers forest stand in which 50 percent or more of the volume or number of small trees is black spruce (common associates include tamarack, balsam fir, and white-cedar).

TAMARACK TYPE (T).—Swamp conifers forest stand in which 50 percent or more of the volume or number of small trees is tamarack (common associates include black spruce and white-cedar).

CEDAR TYPE (C).—Swamp conifers forest stand in which 50 percent or more of the volume or number of small trees is white-cedar (common associates include balsam fir, black spruce, and tamarack).

SPRUCE-FIR TYPE (SB).—A mixed hardwood-coniferous stand in which 50 percent or more of the volume or number of small trees is white spruce and balsam fir, singly or in combination (common associates include black spruce, white-cedar, American elm, aspen, and paper birch).

MAPLE-BIRCH (NORTHERN HARDWOOD) TYPE (M).—Forest stand in which 50 percent or more of the volume or number of small trees is sugar maple, basswood, and yellow birch, singly or in combination (common associates include American elm, red oak, aspen, and paper birch).

ELM-ASH-COTTONWOOD (BOTTOM-LAND HARDWOOD) TYPE (BH).—Forest stand in which 50 percent or more of the volume or number of small trees is black ash, green ash, American elm, slippery elm, balsam poplar, and cottonwood, singly or in combination (common associates include red maple, basswood, and aspen).

OAK-HICKORY TYPE (O).—Forest stand in which 50 percent or more of the volume or number of small trees is oaks or hickory, singly or in combination (common associates include basswood and American elm). May be subtyped "scrub oak" (Ox) if the type is capable of producing only fuelwood material.

ASPEN-BIRCH TYPE (OFTEN CALLED THE ASPEN TYPE) (A).—Forest stand in which 50 percent or more of the volume or number of small trees is trembling or largetooth aspen and paper birch, singly or in combination (common associates include jack pine, balsam fir, basswood, and red oak). May be subtyped as "paper birch" (AB) if that species is most common, or as "off-site aspen" (Ax) if the type is not capable of producing sound merchantable pulpwood.

Species Groups

SOFTWOODS.—Includes white pine, red pine, jack pine, white spruce, black spruce, balsam fir, tamarack,

northern white-cedar, and, in a few restricted localities, redcedar.

HARDWOODS.—Consists of all commercial deciduous species including the aspens, unless otherwise specified.

Stand-Size Classes

SAWTIMBER STANDS.—Stands with sawtimber trees having a minimum net volume per acre of 1,500 board-feet, International ¼-inch rule.

POLETIMBER STANDS.—Stands that fail to meet the sawtimber-stand specification, but that are at least 10 percent stocked with poletimber and larger (5.0 inches and larger) trees, and with at least half the minimum volume in poletimber trees. (Poletimber stands carry at least 240 cubic feet per acre.)

SEEDLING-AND-SAPLING STANDS.—Stands not qualifying as either sawtimber of poletimber stands, but having at least 10 percent stocking of trees of commercial species, and with at least half the minimum stocking in seedling and sapling trees.

NONSTOCKED.—Lands qualifying as forest but failing to meet the specifications for sawtimber, poletimber, or restocking stands. May include grass and brush areas.

Tree Classifications

SAWTIMBER TREES.—Trees of commercial species that contain at least one merchantable saw log, as defined by regional practice, and that are of the following minimum diameters at breast height (d. b. h.): Softwoods 9.0 inches and hardwoods 11.0 inches. Merchantable saw logs are at least 8.0 inches in diameter inside bark at the small end; from 8 to 16 feet in length; and suitable for sawing into standard lumber, construction timbers, or ties. In 1936, 10-inch hardwoods were included in sawtimber if they contained a 16-foot No. 3 log or an 8-foot No. 2 log. Softwoods and aspen were estimated to a 6-inch top in 1936.

POLETIMBER TREES.—Trees of commercial species that meet regional specifications of soundness and form and are in the following d. b. h. range: softwoods, 5.0 to 8.9 inches; hardwoods, 5.0 to 10.9 inches. Such trees usually become sawtimber trees if left to grow.

SEEDLINGS AND SAPLINGS.—Trees of commercial species below 4.9 inches d. b. h.

CULL TREES.—Live trees of sawtimber or poletimber size, unmerchantable for saw logs now or prospectively because of defect, rot, or species. Excepted are trees of pulp species, such as black spruce, which do not normally grow to log size and are not culled if they are of a quality suitable for pulping.

Diameter Measurements

DIAMETER AT BREAST HEIGHT (D. B. H.).—Tree-stem-diameter in inches measured outside bark at 4.5 feet above the ground level.

DIAMETER CLASS.—Trees grouped into 2-inch diameter classes, each class including diameters 0.9 inch higher and 1.0 inch below the midpoint of the class, e. g., the 6-inch class would include trees having diameters from 5.0 to 6.9 inches d. b. h.

Volume Classifications

ALL TIMBER VOLUME.—Net volume in cubic feet of live and salvageable dead sawtimber trees and poletimber trees of commercial species and cull trees of all species, from stump to a minimum 4.0-inch top diameter inside bark. Includes bole only of softwoods but both bole and limbs of hardwoods to a minimum 4.0-inch diameter inside bark.

LIVE ALL-TIMBER VOLUME.—Net volume in cubic feet of live sawtimber trees and live poletimber trees of commercial species, and cull trees of all species.

SAWTIMBER VOLUME.—Net volume in board-feet, International ¼-inch rule, of live and salvageable dead sawtimber trees between the stump and designated upper limits of merchantability. Minimum top diameter for hardwoods is 8 inches and for softwoods 6 inches.

LIVE SAWTIMBER VOLUME.—Net volume in board-feet, International ¼-inch rule, of live sawtimber trees.

CORDWOOD VOLUME.—Net volume in poletimber trees or upper stems of sawtimber trees measured in 4- by 4- by 8-foot cords containing approximately 80 cubic feet of peeled wood.

GROWING STOCK VOLUME.—Net volume in cubic feet of the central stem of live sawtimber trees and live poletimber trees from stump to a minimum merchantable 4.0-inch diameter. Excludes dead trees, cull trees, and hardwood limbs.

PULPWOOD VOLUME.—The total growing stock volume of black spruce, white spruce, balsam fir, jack pine, and aspen.

LOG GRADES.—Specifications for log grades are as follows:

Grade factors	Grade 1				Grade 2			Grade 3
	Hardwood (except aspen)		Red and white pine	Aspen	Hardwood (except aspen)	Red and white pine	Aspen	All species
	Butts only	Butts and uppers						
Diameter (minimum) small end of log---inches	[1] 13	[1] 16	16	9	[1] 11	12	9	8
Length (minimum)---feet	10	10	10	8	8	10	8	[2] 5
Clear cuttings (on the 3 best faces): [3]								
Length (minimum)---do	7	5	----	----	3	----	----	2
Number on face	2	2	----	----	2	----	----	(4)
Yield in face length (each of 3 faces)	5/6	5/6	3/4	1/4	1/6	1/2	----	3/6
Yield in face length (each of 2 faces)	----	----	----	----	----	3/4	1/4	----
Sweep and crook deduction (maximum)---percent	15	15	----	----	30	----	----	50
Total defect, including sweep (maximum)---do	40	40	25	0	50	50	30	60

[1] For basswood and ash, drop 1 inch in d. i. b.: 12, 15, and 10.

[2] Only 5 feet merchantable length is required except in a 1-bolt tree where a minimum of 8 feet is required.

[3] *Ties and timber logs* are not graded on a "cutting" basis. They will be graded 2 or 3, depending on diameter and length specifications. The following minimum rules apply to both grades 2 and 3. Sound knots are permitted if diameter of the knot collar (flush with surface of the log) is not more than 1/3 of log diameter at that point; whorles or grouped knots are allowed if their aggregate collar diameters occurring within a 6-inch vertical distance do not exceed 1/3 of the log diameter at that point; and any number of sound defects of any size are permitted if they can be slabbed off. No unsound internal defect is permitted, and sweep, in inches, must not exceed 1/4 d. i. b. at small end of the log.

[4] Unlimited.

Growth

NET ANNUAL GROWTH.—The change in net volume of sawtimber or growing stock on commercial forest land during a specified year.

INGROWTH.—The total volume of all trees that during the year or period reach minimum diameter for poletimber (5.0 inches); or for sawtimber (9.0 inches for softwoods and 11.0 inches for hardwoods).

Mortality

MORTALITY OF GROWING STOCK.—The net cubic-foot volume removed from growing stock on commercial forest land during a specified period through death from natural causes. Also includes the loss of volume from increase in percentage of defect in the trees and stands with advancing age.

Allowable Cut

The volume of live sawtimber and poletimber that can be cut during a given period while building up or maintaining sufficient growing stock to meet specified growth goals. For Methodology see page 23.

Timber Cut

ANNUAL CUT OF GROWING STOCK.—The net cubic-foot volume of live sawtimber and poletimber trees cut or killed by logging, or by land clearing and cultural operations, on commercial forest land during a specified year.

ANNUAL CUT OF SAWTIMBER.—The net board-foot volume of live sawtimber trees cut or killed by logging, and by land clearing and cultural operations, on commercial forest land during a specified year.

TIMBER PRODUCTS OUTPUT.—The volume of timber products cut from growing stock and other sources.

LOGGING RESIDUES.—The net cubic-foot volume of live sawtimber and poletimber trees cut or killed by logging on commercial forest land and not converted to timber products.

LAND CLEARING AND CULTURAL OPERATIONS.—The net cubic-foot volume of live sawtimber and poletimber trees cut or killed by land clearing in a specified year and not converted to timber products.

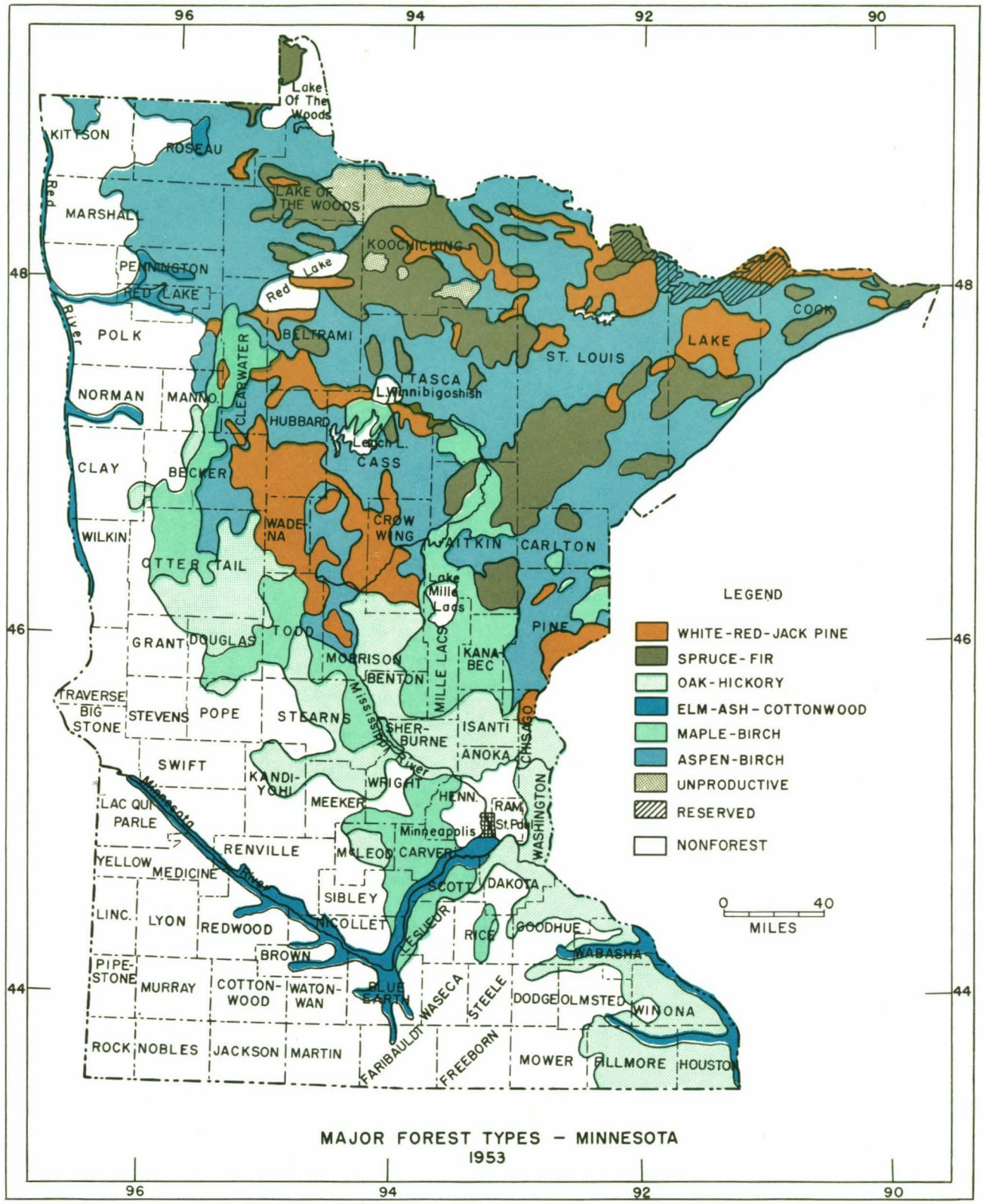
Principal Commercial Forest Trees Recorded on the Minnesota Forest Survey

SOFTWOODS

Summarized as—	*Tallied as—*	*Botanical name*
	White pine	*Pinus strobus*
	Red pine	*P. resinosa*
	Jack pine	*P. banksiana*
	Black spruce	*Picea mariana*
	White spruce	*P. glauca*
	Balsam fir	*Abies balsamea*
	Tamarack	*Larix laricina*
Cedar	White-cedar	*Thuja occidentalis*
	Redcedar	*Juniperus virginiana*

HARDWOODS

	Sugar maple	*Acer saccharum*
Soft maple	Red maple	*A. rubrum*
	Silver maple	*A. saccharinum*
	Yellow birch	*Betula alleghaniensis*
	Basswood	*Tilia americana*
	American elm	*Ulmus americana*
Elm	Slippery elm	*U. rubra*
	Rock elm	*U. thomasii*
Red Oak	Red oak	*Quercus rubra* *Q. coccinea* *Q. velutina* *Q. ellipsoidalis*
	White oak	*Q. alba*
Other white oaks	Bur oak	*Q. macrocarpa*
	Swamp white oak	*Q. bicolor*
Aspen	Trembling aspen	*Populus tremuloides*
	Bigtooth aspen	*P. grandidentata*
	Balsam poplar	*P. balsamifera*
	Cottonwood	*P. deltoides*
	Paper birch	*Betula papyrifera*
Ash	Black ash	*Fraxinus nigra*
	White ash	*F. americana*
	Green ash	*F. pennsylvanica*
	Hickory	*Carya* spp.
	Black walnut	*Juglans nigra*
Other hardwoods	Hackberry	*Celtis occidentalis*
	Black cherry	*Prunus serotina*
	Willow	*Salix* spp.
	Boxelder	*Acer negundo*
	Ironwood	*Ostrya virginiana*
	Butternut	*Juglans cinerea*



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